sierra research

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Alaska Rural Communities Emission Inventory

prepared for:

Western Governors' Association
Western Regional Air Partnership
Alaska Dept. of Environmental Conservation

February 2007

prepared by:

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Alaska Rural Communities Emission Inventory

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1. EXECUTIVE SUMMARY

The Western Regional Air Partnership (WRAP) is a collaborative effort of tribal governments, state governments, and various federal agencies to implement the recommendations of the Grand Canyon Visibility Transport Commission and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. Environmental Protection Agency's (EPA's) regional haze rule. Other common western regional air quality issues raised by the WRAP membership may also be addressed. WRAP activities are conducted by a network of committees and forums composed of WRAP members and stakeholders who represent a wide range of viewpoints.

Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Whether Board members or not, it must be remembered that all tribes are governments, as distinguished from the "stakeholders" (private interests) who participate on Forums and Committees but are not eligible for the Board. Despite this equality of representation on the Board, tribes are very differently situated than states. There are over 400 federally recognized tribes in the WRAP region, including Alaska. The sheer number of tribes makes full participation impossible. Morever, many tribes are faced with pressing environmental, economic, and social issues, and do not have the resources to participate in an effort such as the WRAP, however important its goals may be. These factors necessarily limit the level of tribal input into and endorsement of WRAP products. The tribal participants in the WRAP, including Board members, Forum and Committee members, and co-chairs, make their best effort to ensure that WRAP products are in the best interest of the tribes, the environment, and the public. One interest is to ensure that WRAP policies, as implemented by states and tribes, will not constrain the future options of tribes who are not involved in the WRAP. This project was designed and implemented with significant assistance from National Tribal Environmental Council staff, WRAP tribal representatives, and tribal organizations and members from Alaska tribes.

The EPA regional haze rule calls for visibility improvements in the national parks and wilderness areas in the country through the cooperation of state, tribal, and federal agencies. In order to identify the major sources of regional haze pollution, sources of visibility-related pollutants (mostly fine particulates) need to be analyzed and inventoried. The WRAP Emissions Forum is tasked with compiling emission inventory information for use in meeting regional haze rule requirements.

Previous analyses of air emission inventories in Alaska have focused efforts on emissions from the three primary urban boroughs (Municipality of Anchorage, Fairbanks North Star, and Juneau), aviation sources, and commercial marine sources at the major ports and harbors in the state. However, little work has been done to quantify air emissions for

non-aviation sources in rural Alaska and for the smaller ports and harbors scattered throughout the state. Under contract to the Western Governors' Association (WGA), WRAP, and the Alaska Department of Environmental Conservation (ADEC), Sierra Research, Inc. (Sierra) conducted this study to develop calendar year 2005 and projected 2018 seasonal area, on-road, and off-road emission inventories for the remaining 24 boroughs and census areas[*] (made up of 365 rural communities) in Alaska. In addition, separate seasonal commercial marine inventories for the smaller ports and harbors in all of the boroughs (a total of over 160 ports and harbors) were developed for 2005 and 2018.

The basic approach used to estimate emissions from the rural communities consisted of:

- Collecting information on 2005 seasonal activity and fuel use from 13 representative rural communities in the state using surveys;
- Developing emissions inventories for those representative rural communities;
- Extrapolating those results to other communities within EPA's National Emissions Inventory county or borough scheme for Alaska based on similarities in geography, location, and size; and
- Projecting the 2005 emission inventories to 2018 using estimated population growth forecasts and future emission factors.

The survey approach used in this study was novel. Although originally conceived as a one-year study, it took three years to collect information from a sufficient number of communities that could be used to represent the cross-section of rural communities in the state. About 75% of the time and resources allocated to this study was spent recruiting communities and collecting survey data. The remainder was directed at developing inventories for the "representative communities" and extrapolating those results to the rest of rural Alaska. The study, however, produced a framework for estimating fuel use and emissions in rural Alaska that can be updated in the future as new information is obtained.

Table 1-1 shows the borough-wide 2005 emission inventories estimated in this study along with the estimated statewide inventory for comparison. Somewhat surprisingly, the rural communities in Alaska are estimated to contribute over 95% of the statewide hydrocarbon (HC) emissions and 80% of the statewide particulate matter (PM) emissions even though they contain only about 40% of the statewide population. HC and PM emissions in rural communities come from two primary sources—wood burning and fugitive dust.

[*] Alaska has organized boroughs and unorganized areas defined by census areas. Hereafter in this document the term borough may apply to either organized boroughs or unorganized census areas.

Wood burning is associated with high HC, carbon monoxide (CO), and PM emissions, while fugitive dust from unpaved roads contributes significantly to ambient PM_{10} levels. Wood burning is especially prevalent in Matanuska-Susitna, Southeast Fairbanks, and Denali, all of which show disproportionately high HC, CO, PM_{10}, and $PM_{2.5}$ emissions. Even when compared to emissions from the large urban boroughs of Anchorage, Fairbanks, and Juneau as shown in Table 1-2, emissions from wood burning and fugitive dust in the rural communities dominate the statewide inventory. Note, however, that responses from the representative community surveys were utilized as they were received, which, in some cases, included questionably high wood use estimates, as discussed in greater detail in the report.

Table 1-3 shows the projected 2018 emission inventories by borough, and Table 1-4 presents the percentage change in population and emissions from 2005 to 2018. The emission inventory changes between 2005 and 2018 are generally proportional to the changes in population. Emissions from on- and off-road vehicles and equipment are lower on average in 2018 as compared to 2005 due to turnover to newer engines that meet more stringent emission standards and the reduction of sulfur in both gasoline and Diesel fuel. However, projected emissions from wood combustion and fugitive dust still dominate the emissions inventory in 2018.

A previous analysis of the major ports in Alaska yielded commercial marine vessel emission inventories for the nine largest ports in the state.[1*] However, air emissions from commercial marine vessels operating in over 160 smaller ports and harbors in Alaska have not been previously estimated. In this study, commercial marine vessel emission inventories for the smaller ports and harbors were developed based on activity estimates from schedules, route lists, and vessel registration records. Port calls were estimated for the main vessel types: tugs, fishing vessels, ferries, and cruise ships. Emission factors and activity assumptions from the analysis of the major ports in Alaska cited above were used to generate seasonal emission inventories for the smaller ports and harbors, and borough-wide totals were then calculated for all of the 27 boroughs in Alaska.

Results of the analysis of commercial marine vessels at the smaller ports and harbors are shown in Table 1-5 and Table 1-6 by borough for 2005 and 2018, respectively. The total inventories from the previously analyzed nine largest ports are also shown in the tables for comparison. As observed in the tables, the commercial marine inventory for the smaller ports and harbors makes up about 40% of the estimated statewide commercial marine inventory. The substantial emission reduction of SOx between 2005 and 2018 is due to the required use of low-sulfur fuel in the future. As discussed in more detail in the report, the HC and CO emissions for the smaller ports and harbors are primarily from commercial fishing vessels, while the NOx inventory is dominated by emissions from cruise ships (with activity concentrated in the southeastern portion of the state) and ferries.

[*] Superscripts denote references provided in Section 8.

Table 1-1
Total 2005 Survey-Based Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine and Aviation)

Borough	2005 Population	Communities	Annual Emissions (tons/year)						
			HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	67,210	28	155,930	124,618	5,150	94,220	29,984	531	31
Kenai Peninsula	51,133	38	75,464	65,860	11,710	33,580	11,804	1,485	18
Bethel	17,086	37	15,352	14,953	1,126	3,292	1,845	56	2
Valdez-Cordova	10,508	26	11,204	7,404	690	6,265	1,973	26	1
Kodiak Island	9,640	17	12,081	10,228	1,238	5,859	1,981	135	3
Nome	9,333	21	12,162	10,986	557	5,772	1,926	25	1
Sitka	8,947	1	320	2,277	540	803	213	35	4
Ketchikan Gateway	8,090	2	656	2,399	486	971	256	32	4
Wade Hampton	7,863	20	12,084	10,743	643	6,453	2,014	23	1
Northwest Arctic	7,094	12	6,243	9,267	322	2,561	847	13	1
North Slope	6,905	11	6,068	8,934	293	2,493	824	12	1
Southeast Fairbanks	6,379	18	14,878	12,278	1,825	8,967	2,867	50	3
Wrangell-Petersburg	5,848	6	856	2,075	349	959	251	24	3
Yukon-Koyukuk	5,679	40	8,254	8,093	402	6,054	1,825	35	1
Aleutians West	5,248	8	8,837	7,960	1,304	3,657	1,331	173	2
Prince of Wales	4,893	15	4,606	5,353	270	3,393	873	23	3
Dillingham	4,746	11	4,927	4,658	1,246	2,612	837	151	2
Skagway-Angoon	3,029	12	2,839	3,264	166	2,100	540	14	2
Aleutians East	2,657	9	75	385	756	853	148	80	0
Haines	2,125	6	1,945	2,110	111	1,472	378	10	1
Denali	1,951	5	4,558	3,739	385	2,740	874	15	1
Lake & Peninsula	1,598	18	45	232	455	513	89	48	0
Bristol Bay	1,073	3	30	155	305	345	60	32	0
Yakutat	619	1	583	677	34	429	110	3	0
Total Rural Communities	249,654	365	360,001	318,650	30,364	196,363	63,853	3,032	84
STATEWIDE[a]	651,337	382	373,506	476,695	40,949	244,178	79,183	3,762	449

[a] Statewide totals include 2002 Inventories for Municipality of Anchorage, Fairbanks, and Juneau and are included for comparison purposes.

Table 1-2
Total Annual Emission Inventories for Alaska[a]
(Excludes Point Sources, Commercial Marine and Aviation)

Borough	2005 Population	Communities	Annual Emissions (tons/year)						
			HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Municipality of Anchorage	310,474	4	5,110	47,085	4,380	16,425	4,380	365	0
Fairbanks North Star	54,934	11	6,935	98,915	4,015	28,470	10,220	365	365
Juneau	36,275	2	1,460	12,045	2,190	2,920	730	0	0
All Other Boroughs	249,654	365	360,001	318,650	30,364	196,363	63,853	3,032	84
TOTAL	651,337	382	373,506	476,695	40,949	244,178	79,183	3,762	449

[a]The most recent 2002 inventories were used for the Municipality of Anchorage, Fairbanks North Star, and Juneau for comparison purposes.

Table 1-3
Total Projected 2018 Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine and Aviation)

Borough	2018 Population	Communities	Annual Emissions (tons/year)						
			HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	123,616	28	279,652	210,254	8,948	173,171	55,034	917	57
Kenai Peninsula	62,487	38	92,785	75,517	14,237	42,073	14,954	1,844	24
Bethel	20,738	37	17,298	15,354	1,430	3,756	2,142	66	2
Valdez-Cordova	12,104	26	12,844	8,279	816	7,215	2,270	27	1
Kodiak Island	9,177	17	10,517	8,326	1,227	5,433	1,807	132	3
Nome	10,258	21	13,210	10,955	666	6,520	2,156	27	1
Sitka	9,245	1	331	2,353	558	830	221	37	4
Ketchikan Gateway	7,446	2	546	2,061	431	855	225	28	3
Wade Hampton	9,834	20	14,875	12,220	852	8,066	2,515	28	1
Northwest Arctic	7,612	12	5,972	7,485	531	2,736	898	13	1
North Slope	5,887	11	4,611	5,708	392	2,115	694	10	1
Southeast Fairbanks	8,753	18	19,876	15,439	2,363	12,293	3,923	65	4
Wrangell-Petersburg	4,869	6	641	1,542	277	769	200	18	2
Yukon-Koyukuk	5,457	40	8,219	7,423	393	6,058	1,832	34	1
Aleutians West	4,986	8	8,425	7,034	1,212	3,581	1,317	164	2
Prince of Wales	4,117	15	3,578	3,722	201	2,848	729	9	2
Dillingham	4,523	11	4,205	3,719	1,174	2,429	764	141	1
Skagway-Angoon	2,812	12	2,438	2,507	135	1,946	498	6	2
Aleutians East	2,627	9	62	317	734	843	146	77	0
Haines	3,880	6	3,241	2,752	146	2,682	685	8	2
Denali	2,980	5	6,775	5,268	703	4,184	1,334	22	1
Lake & Peninsula	1,475	18	35	178	412	473	82	43	0
Bristol Bay	764	3	18	92	213	245	42	22	0
Yakutat	310	1	269	280	15	214	55	1	0
Total Rural Communities	325,959	365	510,423	408,785	38,067	291,337	94,526	3,739	117

Table 1-4
% Change in Population and Emissions from 2005 to 2018 by Borough
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	Population Change	Change in Total Annual Emissions						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	84%	79%	69%	74%	84%	84%	73%	86%
Kenai Peninsula	22%	23%	15%	22%	25%	27%	24%	29%
Bethel	21%	13%	3%	27%	14%	16%	17%	23%
Valdez-Cordova	15%	15%	12%	18%	15%	15%	1%	16%
Kodiak Island	-5%	-13%	-19%	-1%	-7%	-9%	-2%	-6%
Nome	10%	9%	0%	20%	13%	12%	8%	6%
Sitka	3%	3%	3%	3%	3%	3%	3%	3%
Ketchikan Gateway	-8%	-17%	-14%	-11%	-12%	-12%	-13%	-11%
Wade Hampton	25%	23%	14%	32%	25%	25%	23%	26%
Northwest Arctic	7%	-4%	-19%	65%	7%	6%	5%	7%
North Slope	-15%	-24%	-36%	34%	-15%	-16%	-17%	-15%
Southeast Fairbanks	37%	34%	26%	29%	37%	37%	29%	39%
Wrangell-Petersburg	-17%	-25%	-26%	-21%	-20%	-20%	-25%	-19%
Yukon-Koyukuk	-4%	0%	-8%	-3%	0%	0%	-3%	26%
Aleutians West	-5%	-5%	-12%	-7%	-2%	-1%	-5%	-1%
Prince of Wales	-16%	-22%	-30%	-26%	-16%	-17%	-60%	-15%
Dillingham	-5%	-15%	-20%	-6%	-7%	-9%	-6%	-6%
Skagway-Angoon	-7%	-14%	-23%	-18%	-7%	-8%	-56%	-6%
Aleutians East	-1%	-18%	-18%	-3%	-1%	-2%	-4%	0%
Haines	83%	67%	30%	32%	82%	81%	-18%	80%
Denali	53%	49%	41%	82%	53%	53%	44%	55%
Lake & Peninsula	-8%	-23%	-23%	-9%	-8%	-8%	-10%	-6%
Bristol Bay	-29%	-41%	-41%	-30%	-29%	-29%	-31%	-28%
Yakutat	-50%	-54%	-59%	-56%	-50%	-50%	-76%	-49%
Total Rural Communities	31%	42%	28%	25%	48%	48%	23%	40%

Table 1-5
Total 2005 Commercial Marine Vessel Emission Inventories by Borough
(Borough Totals Exclude 9 Largest Ports)

Borough	Annual Emissions (tons/year)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	2.15	25.90	36.45	1.00	0.97	9.06	0.03
Aleutians West	0.41	5.01	7.12	0.19	0.19	1.79	0.01
Anchorage	0.58	8.08	4.83	0.13	0.13	1.04	0.01
Bethel	5.51	97.60	14.10	0.27	0.26	2.03	0.08
Bristol Bay	0.76	9.61	7.95	0.23	0.22	1.79	0.01
Dillingham	3.43	49.01	26.57	0.73	0.71	5.69	0.05
Fairbanks North Star	0.30	4.30	2.41	0.07	0.06	0.52	0.00
Haines	6.12	46.45	285.32	12.69	12.30	103.75	0.11
Juneau	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kenai Peninsula	6.34	71.02	150.11	6.06	5.87	49.32	0.10
Ketchikan Gateway	0.26	2.97	3.12	0.09	0.09	0.71	0.00
Kodiak Island	0.86	12.69	18.26	0.46	0.45	4.86	0.02
Lake & Peninsula	1.39	18.61	15.54	0.43	0.42	3.62	0.02
Matanuska-Susitna	0.96	12.31	9.64	0.28	0.27	2.14	0.01
Nome	1.35	23.40	4.20	0.09	0.09	0.69	0.02
North Slope	0.01	0.23	0.07	0.00	0.00	0.02	0.00
Northwest Arctic	0.14	2.42	0.51	0.01	0.01	0.10	0.00
Prince of Wales	5.28	63.77	181.49	6.20	6.01	57.08	0.10
Sitka	30.09	151.13	881.03	63.35	61.44	451.47	0.39
Skagway-Angoon	36.84	204.84	1,379.81	78.69	76.32	570.64	0.49
Southeast Fairbanks	0.07	0.62	1.24	0.04	0.04	0.29	0.00
Valdez/Cordova	42.20	225.25	1,426.93	86.97	84.36	610.39	0.51
Wade Hampton	2.10	38.27	3.81	0.05	0.05	0.38	0.03
Wrangell-Petersburg	14.36	147.43	519.31	20.07	19.46	172.87	0.26
Yakutat	1.22	20.25	9.41	0.23	0.22	2.21	0.02
Yukon-Koyukuk	0.20	3.48	1.65	0.04	0.04	0.40	0.00
Total Small Ports and Harbors	162.94	1,244.65	4,990.86	278.36	269.97	2,052.83	2.30
Total for 9 Largest Ports	233.40	1,997.30	7,322.20	440.50	345.67[a]	4,541.00[a]	3.80
STATEWIDE	396.34	3,241.95	12,313.06	718.86	615.64	6,593.83	6.10

[a] Values from Pechan report were corrected to $1/10^{th}$ of reported $PM_{2.5}$ and 10 times the reported SOx levels (errors found in reported levels).

Table 1-6
Total 2018 Commercial Marine Vessel Emission Inventories by Borough
(Borough Totals Exclude 9 Largest Ports)

Borough	Annual Emissions (tons/year)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	2.58	36.54	39.13	0.97	0.94	0.29	0.05
Aleutians West	0.49	7.05	7.56	0.19	0.18	0.06	0.01
Anchorage	0.70	11.64	5.64	0.13	0.13	0.04	0.01
Bethel	6.65	140.41	15.79	0.26	0.25	0.06	0.12
Bristol Bay	0.92	13.83	9.19	0.22	0.21	0.06	0.02
Dillingham	4.15	70.56	30.94	0.72	0.69	0.20	0.07
Fairbanks North Star	0.37	6.19	2.81	0.07	0.06	0.02	0.01
Haines	10.18	67.21	365.89	19.07	18.49	4.07	0.16
Juneau	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kenai Peninsula	8.75	102.24	187.44	8.55	8.29	1.89	0.15
Ketchikan Gateway	0.31	4.28	3.64	0.09	0.09	0.02	0.01
Kodiak Island	1.03	17.53	17.95	0.45	0.44	0.14	0.02
Lake & Peninsula	1.68	26.62	17.35	0.42	0.41	0.12	0.03
Matanuska-Susitna	1.16	17.72	11.25	0.27	0.26	0.07	0.02
Nome	1.63	33.66	4.72	0.09	0.08	0.02	0.03
North Slope	0.01	0.32	0.06	0.00	0.00	0.00	0.00
Northwest Arctic	0.16	3.47	0.52	0.01	0.01	0.00	0.00
Prince of Wales	7.10	87.57	201.84	8.02	7.77	1.96	0.14
Sitka	31.07	175.97	880.74	63.26	61.36	417.13	0.42
Skagway-Angoon	67.67	345.96	2,089.50	129.89	125.99	25.33	0.84
Southeast Fairbanks	0.09	0.89	1.45	0.04	0.03	0.01	0.00
Valdez/Cordova	78.04	394.14	2,268.45	146.36	141.97	27.98	0.92
Wade Hampton	2.54	55.07	4.26	0.05	0.05	0.01	0.05
Wrangell-Petersburg	20.70	206.58	619.50	27.93	27.09	6.36	0.37
Yakutat	1.47	28.88	9.73	0.22	0.22	0.07	0.03
Yukon-Koyukuk	0.24	4.95	1.63	0.04	0.04	0.01	0.00
Total Small Ports and Harbors	249.72	1,859.30	6,796.99	407.31	395.05	485.92	3.47
Total for 9 Largest Ports	368.00	2,904.50	9,572.90	633.50	827.70	653.10	5.90
STATEWIDE	617.72	4,763.80	16,369.89	1,040.81	1,222.75	1,139.02	9.37

###

2. INTRODUCTION

Background

The Western Regional Air Partnership (WRAP) is a collaborative effort of tribal governments, state governments, and various federal agencies to implement the recommendations of the Grand Canyon Visibility Transport Commission and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. Environmental Protection Agency's (EPA) regional haze rule. Other common western regional air quality issues raised by the WRAP membership may also be addressed. WRAP activities are conducted by a network of committees and forums composed of WRAP members and stakeholders who represent a wide range of viewpoints.

Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Whether Board members or not, it must be remembered that all tribes are governments, as distinguished from the "stakeholders" (private interests) who participate on Forums and Committees but are not eligible for the Board. Despite this equality of representation on the Board, tribes are very differently situated than states. There are over 400 federally recognized tribes in the WRAP region, including Alaska. The sheer number of tribes makes full participation impossible. Morever, many tribes are faced with pressing environmental, economic, and social issues, and do not have the resources to participate in an effort such as the WRAP, however important its goals may be. These factors necessarily limit the level of tribal input into and endorsement of WRAP products. The tribal participants in the WRAP, including Board members, Forum and Committee members, and co-chairs, make their best effort to ensure that WRAP products are in the best interest of the tribes, the environment, and the public. One interest is to ensure that WRAP policies, as implemented by states and tribes, will not constrain the future options of tribes who are not involved in the WRAP. This project was designed and implemented with significant assistance from National Tribal Environmental Council staff, WRAP tribal representatives, and tribal organizations and members from Alaska tribes.

The EPA regional haze rule calls for visibility improvements in the national parks and wilderness areas in the country through the cooperation of state, tribal, and federal agencies. In order to identify the major sources of regional haze pollution, sources of visibility-related pollutants (mostly fine particulates) need to be analyzed and inventoried. The WRAP Emissions Forum is tasked with compiling emission inventory information for use in meeting regional haze rule requirements.

Historically, EPA has developed statewide emission estimates under a national effort for areas, sources, and pollutants not explicitly addressed in the SIP-related inventories compiled for Anchorage, Fairbanks, and Juneau. The existing Alaska statewide inventory developed by EPA is plagued by extrapolation of ill-suited source-surrogates and temporal and spatial relationships developed from "lower 48" studies that produce large inaccuracies and inconsistencies when applied to a vast, complex state like Alaska.

With this backdrop, this study aimed to quantify emissions from the smaller rural communities in Alaska using information collected locally or from similar communities in the state. Some of the communities are located near Alaskan Class I areas and estimates of their emissions are likely to be important in developing control programs for regional haze.

Alaska has four Class I areas that are impacted by the Regional Haze Rule:

- Denali National Park and Preserve is located 240 miles north of Anchorage in the center of the Alaska Range. The park area totals more than 6 million acres. Denali is the only Class I site in Alaska that is easily accessible, is connected to the road system, and accommodates a wide variety of visitor uses.

- Tuxedni Wilderness Area is located in southcentral Alaska, in western lower Cook Inlet at the mouth of Tuxedni Bay. Tuxedni is composed of two islands, Chisik and Duck, totaling 6,402 acres. Tuxedni Wilderness Area is accessible only by small boats and planes, weather permitting.

- Simeonof Wilderness Area is located in the Aleutian Chain 58 miles from the mainland. It is one of 30 islands that make up the Shumagin Group on the western edge of Alaska. The island has an area of 25,141 acres. Access to Simeonof is difficult due to its remoteness and the unpredictable weather.

- Bering Sea Wilderness Area is located off the western coast of Alaska approximately 275 miles southwest of Nome. The Class I area consists of 41,113 acres and is made up of the St. Matthew Island Group (which totals approximately 81,340 acres). The Bering Sea Wilderness Area is one of the most isolated landmasses in the United States, with few if any visitors.

Neither the Simeonof nor Bering Sea Class I area is likely to be impacted by emissions from the two principal population centers in the state (i.e., Anchorage and Fairbanks). Their location emphasizes the need to account for activity and emissions from rural areas and communities that are not located on the Alaska Highway System. Located between Anchorage and Fairbanks, the Denali National Park and Preserve may be impacted by emissions from both cities and emphasizes the need to account for emissions from communities located on the Alaska Highway System, as well as rural and outlying areas.

Tuxedni sits on the west side of the Cook Inlet, roughly 120 miles southwest of Anchorage. It is not yet clear how much impact it receives from Anchorage or smaller communities on the Kenai Peninsula.

In order to estimate emissions from the smaller rural communities in Alaska and quantify potential effects on the Class I areas in the state, activity and fuel use data were collected from representative small and mid-size communities in Alaska. The data were used to (a) develop 2005 emission inventories for the selected communities, (b) share the results with those communities, (c) extrapolate emissions to other communities within EPA's National Emissions Inventory (NEI) county scheme for Alaska, and (d) project the county- or borough-wide emission inventories to 2018. The following describes the overall approach used in the study.

Approach

The approach for the analysis follows the methodology described in the inventory preparation and quality assurance (IP/QA) plan submitted to WRAP and included in Appendix A of this report. Analyses have been conducted and emission inventories estimated for a number of sources in Alaska in an effort to quantify all air pollution sources in the state. Emissions that are well characterized include those from:

- Point sources;
- Aviation sources (aircraft and GSE/APU[*]);[2]
- Commercial marine vessels at nine major ports;[†] and
- The major urban boroughs of Anchorage, Fairbanks North Star, and Juneau.

Outside of the Municipality of Anchorage, Fairbanks North Star, and Juneau, little is known about emission levels and sources of emissions in the other 24 boroughs in the state, which are made up of mostly small rural communities. Alaska has about 45 mid-size communities with populations between 2,000 and 60,000 and about 329 small communities with populations below 2,000. In addition, emission estimates for commercial marine vessels are limited only to the nine largest ports in the state, which leaves out over 160 ports and harbors in Alaska that have commercial marine vessel traffic.

A survey of each community would yield the necessary data to develop a complete emission inventory for the entire state. However, given the monumental task of contacting each of over 360 communities and analyzing any data that could be collected, a framework was designed to choose representative communities for which data were collected, and results were extrapolated to the rest of the rural communities in the state. Moreover, activity and emissions from commercial marine vessels at the smaller ports

[*] Ground support equipment and auxiliary power units

[†] The nine largest ports include Anchorage, Dutch Harbor, Homer, Nikiski, Juneau, Ketchikan, Kivalina, Kodiak, and Valdez.

and harbors in Alaska were estimated. The framework includes the steps briefly described below, details of which are provided in this report.

Representative Community Selection – Thirteen communities in Alaska were chosen to represent others based on varying geography, location, and size:

- Arctic Village,
- Bethel,
- Buckland,
- Dillingham,
- Huslia,
- Klawock,
- Kongiganak,
- Minto,
- Northway Village,
- Port Graham,
- Sand Point,
- Sitka, and
- Stebbins.

Survey Design and Implementation – After consultation with state, local, and tribal organizations on the format and content of the surveys, residential homes and non-residential facilities in the representative communities were surveyed on seasonal fuel use, motorized equipment and vehicle activity, and outdoor refuse and wood burning habits. Local and tribal personnel facilitated and coordinated the survey distribution and collection, and responses were collected between summer 2004 and winter 2005/2006.

2005 Inventory Development – Resulting activity and fuel use data from the surveys were used, along with emission factors from the U.S. Environmental Protection Agency's (EPA's) AP-42, and NONROAD and MOBILE models, in order to estimate total 2005 emission inventories for HC, CO, NOx, SOx, PM_{10}, $PM_{2.5}$, and ammonia (NH_3). Where available, electric utility fuel use for a community was derived from the 2005 Power Cost Equalization (PCE) report[3] in order to estimate emissions from electricity generation. Complete seasonal emission inventories for the representative communities were developed. For purposes of this analysis, the Alaskan summer and winter are defined as April through September, and October through March, respectively. Where there were gaps in the surveys, data from the other representative communities were utilized with adjustments to account for differences in population and other local conditions.

Countywide Emissions Extrapolation – The resulting total summer and winter emissions for the representative communities were extrapolated to the rest of the small and midsize communities in Alaska. This was done by matching each community with the appropriate representative community based on geography, location, and size, and adjusting the estimated emissions for population differences. The resulting emission

inventories by community were then summed for each county to result in countywide emission estimates.

Commercial Marine Vessels at the Smaller Ports and Harbors – In addition to the survey effort, which yielded data for land-based sources and residential boat use, an analysis of all the ports and harbors in Alaska was performed in order to estimate 2005 emissions from commercial marine vessels in the state. Activity estimates were derived from posted 2005/2006 vessel schedules, route lists, vessel license records, and interviews with harbormasters, where available. Emission factors and missing activity estimates for commercial marine vessels were based on the analysis of the larger ports in the state.

Inventory Projection to 2018 – The 2005 borough-wide emission inventories for the rural communities were forecasted to calendar year 2018 using projected changes in engine emission factors from EPA's MOBILE and NONROAD models for on- and off-road mobile sources, along with estimated 2018 populations extrapolated from 2000 and 2005 population data from the Alaska Department of Commerce, Community and Economic Development.[4] Emissions from area sources were assumed to increase or decrease with population. The 2005 commercial marine vessel inventories for the smaller ports and harbors in Alaska were projected to 2018 using the vessel-specific activity growth and emission reduction factors used in the development of the projected 2018 inventories for the larger ports in the state.

Organization

Following the Executive Summary and this introductory section, Section 3 first describes the community sampling methodology and then presents the surveys developed for the analysis and the results of the surveys. Section 4 discusses the methods used to compute emissions from the data obtained in the surveys and the quality assurance procedures that were employed in the development of the 2005 emission inventory estimates. The inventory development section also describes the methodology used in analyzing emissions from commercial marine vessels at the smaller ports and harbors. The extrapolation of the representative communities' inventories to the rest of the state and the results are discussed in Section 5, and Section 6 describes the methodology used in projecting the 2005 rural and commercial marine vessel emission inventories to 2018. Finally, the study's conclusions are presented in Section 7. Section 8 lists the references cited throughout the report.

###

3. REPRESENTATIVE COMMUNITIES AND SURVEYS

Sampling Plan

In order to effectively sample communities within Alaska, the state was divided into six regions defined by geography. Within the regions, representative communities were chosen to be surveyed for the analysis based on location, population, proximity to Class I areas (where regional haze is a concern), how well they represented other villages within the region, and willingness to participate in the survey effort. The goal was to survey two to three communities within each region; however, the lack of contacts and means for some communities to participate resulted in one region having no representative and another having four. The boroughs of Anchorage, Juneau, and Fairbanks North Star were excluded from the sampling and analysis as inventories have already been developed separately for these major urban boroughs.

Figure 3-1 shows the six regions, along with the representative communities chosen for surveying. Table 3-1 lists the tribal associations involved in facilitating the survey work, along with the representative communities chosen and their populations.

Figure 3-1
Alaska Geographic Regions and Representative Communities

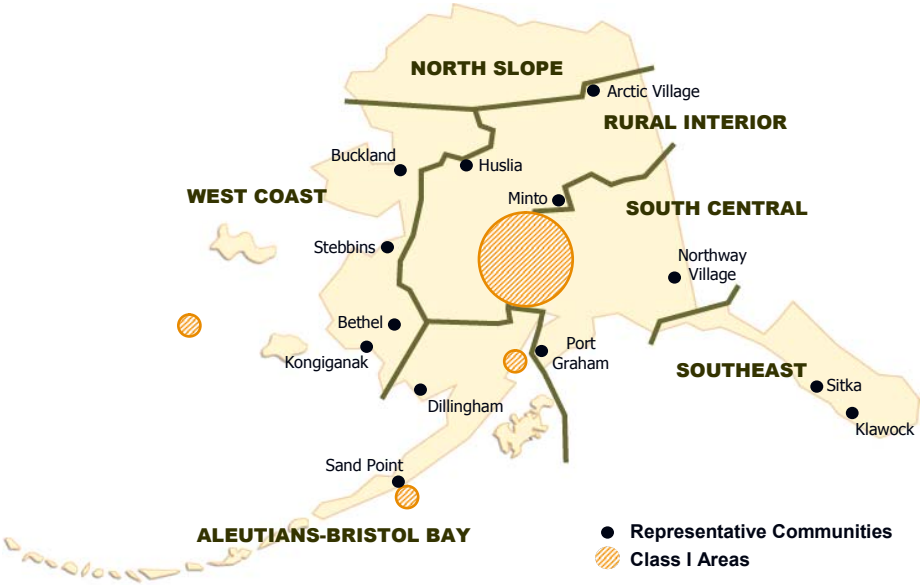

Table 3-1 Representative Communities and Tribal Associations		
Tribal Association	Community	Population
Tanana Chiefs Conference	Arctic Village	147
Assoc. of Village Council Presidents	Bethel	5,960
Kawerak	Buckland	434
Bristol Bay Native Association	Dillingham	2,370
Tanana Chiefs Conference	Huslia	265
Tlingit & Haida Central Council	Klawock	780
Assoc. of Village Council Presidents	Kongiganak	427
Tanana Chiefs Conference	Minto	202
Tanana Chiefs Conference	Northway Village	99
Chugach Miut	Port Graham	134
Aleutian Pribilof Islands Association	Sand Point	939
Tlingit & Haida Central Council	Sitka	8,947
Kawerak	Stebbins	596

Aleutians – Bristol Bay Region – This region is composed of the boroughs of Aleutians West, Aleutians East, Bristol Bay, Lake and Peninsula, Dillingham, Kodiak Island, and the western portion of Kenai Peninsula (west of 150° W longitude). The region is characterized by fishing villages and is adjacent to the Simeonof Wilderness Area, which is an area that must plan to control pollution contributing to regional haze. Two communities were surveyed in this region: Sand Point in the Aleutians East borough and the community of Dillingham in Dillingham census area. The village of Sand Point lies near the Simeonof Wilderness Area and is considered to be representative of other coastal villages in the region. In addition, the community and local council members are well known to contacts within the Alaska Department of Environmental Conservation (ADEC), which facilitated contact and surveying. Dillingham, located in the northern end of Bristol Bay, has more than two times the population of Sand Point and has a slightly different climate that is affected by the arctic conditions of Interior Alaska.

North Slope – Unfortunately, recruitment efforts for community participation in the analysis were unsuccessful in the North Slope region. As a surrogate, survey results from the community of Buckland in the nearby Northwest Arctic borough were used to represent the communities in the North Slope.

West Coast Region – This region is made up of the western half of Bethel (west of 158° W longitude), Wade Hampton, Nome, and Northwest Arctic. It includes a mixture of midsize and small communities located on the coast and along inland rivers. Four communities were surveyed in this region: Kongiganak and Bethel in the Bethel census area, Stebbins in Nome census area, and Buckland in Northwest Arctic borough. The communities vary in population from about 430 for Kongiganak to almost 6,000 for

Bethel.* Buckland and Bethel are along inland rivers and Stebbins and Kongiganak are coastal communities.

Rural Interior Region – This region is made up of the Yukon-Koyukuk census area and the eastern half of the borough of Bethel (east of 158° W longitude). It is composed primarily of small inland river communities off the main highway system. Three communities, all in Yukon-Koyukok, were surveyed—Arctic Village, Huslia, and Minto. Each has a population of less than 300.

South Central Region – This region includes the eastern half of the Kenai Peninsula borough (east of 150° W longitude), Matanuska-Susitna, Denali, Southeast Fairbanks, and Valdez-Cordova. Communities in the region are a mixture of midsize and small communities, with some adjacent to the major urban boroughs of Anchorage and Fairbanks North Star. Most of the communities in this region have access to the main highway system. Recruiting efforts were unable to yield participation from a midsize community in the region, but two smaller communities were surveyed: Port Graham in the Kenai Peninsula and Northway Village in Southeast Fairbanks. Each community has a population of less than 200.

Southeast Region – This region is composed of Yakutat, Haines, Skagway-Hoonah-Angoon, Sitka, Wrangell-Petersburg, Prince of Wales-Outer Ketchikan, and Ketchikan Gateway. It includes a mixture of small and midsize communities, and the climate is more temperate compared to the rest of the state. Two communities were analyzed in this region: Sitka as a midsize community and Klawock in the Prince of Wales borough as a small community. Residential and non-residential surveys were taken for Klawock. However, after consultation with ADEC staff, emissions for Sitka were based on inventory estimates prepared for Juneau adjusted using population and local travel activity.

The representative communities were chosen with input from NTEC staff, ADEC staff, and Alaska Native Coalition on Employment and Training (ANCET) members after assessing the communities' willingness and ability to participate in the survey effort.

Survey Design

Local ANCET or tribal staff members were recruited to facilitate survey distribution and completion where available. For several of the communities, the surveying work involved local ANCET staff located in the community working with community youth groups to collect the data. Prior to surveying, a letter was sent to the local tribal council explaining the purpose of the survey effort and analysis, and post cards were sent to residents to inform them of the study. Lastly, before the final surveys were distributed, drafts were circulated among ANCET, tribe, and community members for comments.

* Populations based on 2005 state demographer estimate from Alaska Department of Commerce, Community and Economic Development.

One residential survey was designed for all communities to assess seasonal fuel and motorized equipment use and outdoor burning activities. For seasonal activity and fuel use at non-residential settings, a set of surveys was developed for each community that was tailored to include all industries, offices, and facilities with possible sources of emissions in the community. Samples of the residential survey and non-residential surveys are included in Appendix B. A description of each survey type is provided below.

Residential Survey – The survey was developed to estimate both emissions and fuel use statistics in the community. The goal was to collect survey responses from at least 30 households for each season. Within a questionnaire designed for in-home interviews, seasonal information was collected on the following:

- Home and camp heating means and fuel use (wood, fuel oil, propane, etc.);
- On-road vehicle (cars, trucks, SUVs, and motorcycles) activity and fuel use;
- Off-road vehicle (four-wheelers, snow machines, and boats) activity and fuel use;
- Home and camp motorized equipment (chain saws, snow blowers, trimmers, generators, pumps, etc.) activity and fuel use;
- Home and camp refuse burning activity; and
- Home and camp outdoor wood burning activity (camp and cook fires, smokehouses, etc.).

Non-Residential Surveys – Non-residential surveys were designed for each representative community to cover all other sources of emissions not addressed in the residential survey. Similar to the residential surveys, information was gathered on both activity and fuel use. The types of facilities surveyed include the following:

- Fuel suppliers;
- Schools;
- Hospitals and clinics;
- Municipal offices;
- Landfills;
- Utilities (electricity generation, water treatment, etc.);
- Harbor and port facilities; and
- Airports.

Sources covered by the non-residential surveys include the same heating, on- and off-road vehicle, motorized equipment, refuse burning, and outdoor burning sources addressed in the residential surveys. Although surveys were prepared for harbors and ports, the information gathered, if any, was used to supplement information gathered on boat activity from the residential surveys and commercial marine activity from the separate analysis of commercial marine vessels. Activity and fuel use data for non-vessel sources at the ports and harbors, such as facility heating, land-based vehicle use, and

land-based motorized equipment use, were gleaned directly from the surveys. Likewise, airport surveys were used to supplement the aircraft and ground support equipment (GSE) sources already included in the completed state inventory. Where available, non-aviation sources, such as construction equipment and heating, were estimated from information gathered from the surveys. Fuel supplier surveys were designed to estimate total fuel use for comparison with combined fuel use results from all sources. As no insight on specific use of the fuel was available, emission estimates were not derived from the fuel supplier surveys.

Survey Responses

Table 3-2 shows the survey responses collected from all of the representative communities. For residential surveys, a minimum target of 30 responses or households per community per season was set, which was met or, in some cases, exceeded. No summer residential surveys were collected for Stebbins. For non-residential surveys, there was limited or no response from facilities in some communities, and, although separate summer and winter surveys were available, some facilities completed only one survey to represent their activity and fuel use for the whole year.

In addition, some surveys were received partially completed. In some instances, fuel/equipment/engine use was indicated but the amount of fuel used or the level of activity for the source was not estimated. When survey questions were not answered (left blank), the activity or fuel use was assumed to be zero, which may have underestimated community totals. These issues with survey responses were found for all of the representative communities. As much as possible, clarifications on the survey responses were made by contacting local residents and tribal/ANCET staff. However, some questionable responses, summarized below, could not be verified by the completion of this study.

- Camp fuel use (especially wood use), expected only during the summer, was indicated during the winter for Arctic Village, Buckland, Dillingham, Kongiganak, Minto, Northway Village, and Port Graham. For Port Graham, camp fuel oil use was indicated only during the winter, and no fuel oil was said to be used in camp during the summer.

- Summer and some winter wood use was estimated to be over 10 cords per month for some households in Arctic Village, Bethel, Klawock, Kongiganak, Northway Village, and Stebbins. This became critical as wood combustion emits considerable amounts of HC, CO, and PM.

- Residential and non-residential survey responses from Bethel showed no Diesel fuel use during the winter for vehicles or equipment.

- No seasonal difference was found for residential wood use in Dillingham households.

Table 3-2
Residential and Non-Residential Surveys Completed

Community	Residential		Non-Residential	
	Summer	Winter	Summer	Winter
Arctic Village	30	31	Fuel Supplier Health Clinic Electric Company Landfill	
Bethel	62	63	None	None
Buckland	30	30	General	General
Dillingham	35	29	City Operations Refuse Wastewater Treatment Facility	None
Huslia	26	30	Landfill City Operations Wastewater Treatment Facility Health Clinic Jimmy Huntington School	
Klawock	50	51	Klawock Island Fuels Electric Utility Klawock Heenya Corporation Landfill Alicia Roberts Medical Center Klawock City School Boat Harbor Wastewater Treatment Facility Village Council Operations Viking Lumber Company	
Kongiganak	29	28	None	
Minto	27	29	Minto Health Clinic Minto School	
Northway Village	30	30	Airport	
Port Graham	29	32	Corporate Operations Clinic Wastewater Treatment Village Council Operations Marine Operations Landfill Airport Fuel Supplier School Homer Electric Association	Corporate Operations Clinic Wastewater Treatment Facility Village Council Operations Marine Operations Landfill Airport Fuel Supplier
Sand Point	18	18	Wastewater Treatment Facility City Operations City Landfill	
			Peter Pan Seafoods TDX Power Corp Fuel Supplier	None
Sitka	DEC data			
Stebbins	None	53	None	None

- Residential wood combustion, Diesel, and gasoline use were indicated only during the summer for Kongiganak.

- Residential Diesel fuel use was indicated only during the winter for Northway Village.

- Motorcycle activity in Port Graham was higher during the winter than during the summer.

In the absence of additional data, the survey responses as they were received were used in the development of the rural communities inventory. The information used in the analysis can be updated as new information become available. The methodology used to generate emission estimates from the survey results follows.

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4. 2005 INVENTORY DEVELOPMENT

Emission Factors and Estimates

The activity and fuel use data derived from the surveys were combined with emission factors from U.S. EPA publications and models. Activity in either frequency of use (hours/day or miles/day) or in total fuel use (gal/week) was employed for estimating emissions depending on the emission factor units. However, it was found that survey responders were more likely to respond to survey questions on frequency of use rather than total fuel use. In addition, fuel use was sometimes expressed in bulk purchase units (e.g., drum, can, cord, load, etc.) rather than in volume or mass used typically for fuel-based emission factors. In order to address these issues, along with the limited responses received, assumptions were made based on interviews with local residents, common measures, and typical or anecdotal use patterns.

For residential sources, the activity and fuel use for the average household were generated from all the residential surveys collected from each community. Emissions were then estimated for the average household, and these were multiplied by the total households in the community to generate the total residential emissions for the community. For non-residential and commercial marine sources, emissions were generated for each facility or port and harbor. As previously noted, a separate analysis of Alaskan ports and harbors based on a previous study of the major ports in Alaska was performed in order to estimate emissions from commercial marine vessels. Details of the inventory development are discussed by source type below.

Heating Sources

The fuels used mainly for heating in Alaska include wood, propane, and fuel oil. Because of how the fuels are purchased, typically in bulk quantities, survey responses on use were based on bulk purchase units instead of mass or volume, which is the basis for U.S. EPA emission factors. The assumptions used for these sources are discussed below by fuel type.

Wood – Used in residential fireplaces, furnaces, and stoves, wood is common as a free or inexpensive source of heat in areas where trees are abundant. Fireplaces and wood stoves are major sources of PM_{10}, $PM_{2.5}$, and CO emissions—the wintertime pollutants traditionally of major concern in Alaska. Emission factors were derived from a U.S. EPA Emission Inventory Improvement Program (EIIP) document on residential wood

combustion[5] and a paper presented at EPA's 10th Annual Emissions Inventory Conference in May 2001.[6] Both contain more current emission factors for wood combustion than those in the U.S. EPA's AP-42 publication.[7] The HC, NOx, and SOx emission factors were derived from the EIIP document and are comparable to those in AP-42. The PM_{10} and CO emission factors for wood-burning fireplaces derived from the conference paper, however, were significantly lower than those found in the most current AP-42 publication. Also according to the conference paper, $PM_{2.5}$ emissions, which are not specified in AP-42, are considered equivalent to the PM_{10} emissions. No NH_3 emissions result from wood combustion.

All the available emission factors are expressed in terms of total emissions per ton of wood burned. However, the amount of wood use was typically expressed in survey responses in terms of a cord, a load, or the number of split logs. The following was assumed for wood quantities and units:

- A wood cord has a volume of 128 cubic feet and a weight of 2,400 pounds (pine dry cord); [8]

- There are approximately 600 split logs per cord (per local wood distributor); and

- An average wood "load" is equivalent to 2.1 times a cord based on an average of the range for a "load" size. A "load" of firewood can mean anything from a loaded lightweight short-bed pickup (about 1/5 of a cord) to a pulpwood truck (about 4 cords).

Propane – In calculating emissions from propane combustion, appropriate AP-42 emission factors[9] were applied to the seasonal fuel use totals indicated in the survey results. $PM_{2.5}$ emissions were assumed to be equivalent to PM_{10} levels, and no NH_3 emissions are emitted during propane combustion. Used in furnaces, stoves, and water heaters, among others, propane or liquefied petroleum gas (LPG) is sold in Alaska in portable "bottles" or pumped from delivery trucks into tanks permanently installed in some areas. Since emission factors are expressed in terms of emissions per 1,000 gallons of propane, the following assumptions were used:

- An average residential propane tank holds 200 pounds or 48 gallons (based on assumed use. The next available tank size is 420 lbs); and

- A propane bottle has an average size of 10.5 pounds or 2.5 gallons (bottle size range from 1 to 20 pounds).

Fuel Oil – In contrast to emission factors for wood burning sources, individual emission factors for various types of fuel oil heaters (e.g., Toyo/Monitor-type stoves vs. central oil furnaces) are not available. Therefore, a single set of AP-42 emission factors,[10] which

were suitable for all residential fuel oil furnaces, was used. Emissions of $PM_{2.5}$ were assumed to be equivalent to PM_{10} levels. No NH_3 emission factor is available for fuel oil combustion; however, any emissions of NH_3 from fuel oil heaters are assumed to be negligible.

The emission factors from AP-42 are expressed in terms of emissions per 1,000 gallons of fuel oil. As with wood and propane, however, survey responses on fuel oil use were sometimes expressed in terms of a bulk purchase size like a "drum." At times, hours of heater operation were given instead of fuel oil use estimates. In order to convert these units and activity into gallons of fuel oil, the following assumptions were used:

- A fuel oil drum is equivalent to 55 gallons (the most common type based on other survey responses); and

- A Toyo or Monitor stove burns 0.2 gallon of fuel oil per hour (per Toyo specifications for house heating at medium duty).

Diesel Power Generation

Emission factors for HC, CO, NOx, SOx, PM_{10}, and $PM_{2.5}$ from AP-42 for large stationary Diesel engines[11] were used to estimate emissions from Diesel fuel combustion for power generation. NH_3 emission factors are not available for Diesel power generation, but are assumed to be negligible (unless added post combustion, any NH_3 present in the fuel is completely converted to NOx). These available emission factors come in units of pounds per MMBtu. In order to convert Diesel use estimates available in gallons of fuel, the following assumptions from AP-42 were used:

- The average Diesel heating value was assumed to be 19,300 Btu per pound; and

- Diesel fuel has a density of 7.1 pounds per gallon.

With the exception of Dillingham, Bethel, Klawock, Port Graham, Arctic Village, and Sitka, the total Diesel fuel used for power generation was obtained from the 2005 Power Cost Equalization (PCE) report. Bethel Utilities Corp. and Nushagak Electric Cooperative in Dillingham are major point sources in the state. Consequently, total annual emissions for the Diesel power generators at both utilities were based on permit levels from ADEC. Total Diesel fuel use for Alaska Power Company (APC) in Klawock was not included in the PCE report (although a participant in the program); however, Diesel fuel use estimates were obtained from the utility through the survey. For Port Graham (Homer Electric Association) and Arctic Village Electric Company, neither of which participates in the PCE program, survey responses received back were incomplete and lacked estimates of their Diesel fuel use. For this reason, annual Diesel fuel use for Port Graham was based on annual electric utility fuel use for Seldovia, and Diesel fuel use for Artic Village was based on that for Huslia, both adjusted using population.

No seasonal data were available from any of the Diesel power generation data sources enumerated above. In the absence of more information on seasonal electricity use, it was assumed that the Diesel fuel used or emissions generated (major point sources) were uniformly distributed throughout the year in all the communities. Emissions from Sitka Electric were not estimated separately, because emissions from electricity generation are already included in the Juneau-based adjusted total emissions for Sitka. The total Diesel fuel used for power generation obtained for the representative communities is shown in Table 4-1.

Table 4-1
2005 Annual Diesel Fuel Used for Power Generation

Community	Population	Diesel Fuel Use (gallons/year)
Arctic Village	147	35,965
Bethel	5,960	3,134,918
Buckland	434	112,719
Dillingham	2,370	1,242,522
Huslia	265	69,440
Klawock	780	12,000
Kongiganak	427	81,967
Minto	202	56,902
Northway Village	99	111,555
Port Graham	134	32,786
Sand Point	939	300,584
Stebbins	596	105,526

On-Road Vehicles

On-road mobile source emissions were developed using EPA's latest vehicle emission factor model, MOBILE6.[12] The model generates motor vehicle emission factors for HC, CO, NOx, SOx, PM_{10}, $PM_{2.5}$, and NH_3. A January 2005 model run was used to generate winter vehicle emission factors, and a July 2004 run was used for the summer. In the absence of information on the vehicle fleet characteristics in the rural communities, the vehicle age distribution and mileage accumulation were based on those found for Anchorage in the Anchorage CO Maintenance Plan. Additional assumptions used in the modeling are shown in Table 4-2. All other parameters used defaults within MOBILE6.

Available survey data on summer and winter miles traveled for each vehicle type were used along with the emission factors obtained from MOBILE6 (expressed in gram/mile) to estimate the seasonal emissions from on-road vehicles.

Table 4-2 MOBILE6 Modeling Assumptions		
Parameter	Summer	Winter
Average Temperature (°F)	70	20
Gasoline Fuel RVP (psi)	12.5	14.7
Fuel Program	Conventional Gasoline West	
Diesel Sulfur Content (ppm)	3,000	

Off-Road Vehicles and Motorized Equipment

The off-road mobile source emission estimates, with the exception of commercial marine vessels, were developed using EPA's NONROAD model.[13] The model calculates emissions from approximately 80 different types of nonroad equipment, and categorizes them by technology type (i.e., gasoline, Diesel, LPG, CNG, 2-stroke, and 4-stroke) and horsepower range. Emissions from off-road equipment can be estimated using either total fuel use or hours of operation. However, as with on-road vehicles, fuel use for off-road vehicles and equipment was rarely estimated in the survey responses; therefore, emissions were based solely on the activity data. The average off-road vehicle or equipment emission factors for HC, CO, NOx, SOx, PM_{10}, $PM_{2.5}$, and NH_3 in pounds per hour of operation were derived from the model using the model outputs for equipment population for the state, equipment-specific emission factors (in grams per horsepower-hour), average horsepower rating, estimated annual equipment activity (hours per year), and average load factor for the given engine.

For some sources such as snow machines, boats, and four-wheelers, survey data provided activity by technology type, and the average technology type-specific emission factors were used for these sources. For the other sources, survey activity data were available by fuel type (mainly Diesel and gasoline), and fuel-specific fleet average emission factors were used accordingly. In cases where neither technology nor fuel type was specified for a vehicle or equipment, the fleet average emission factors for the source were used based on the population and engine type distribution in NONROAD.

Inconsistencies with survey responses and the need for time-based activity (to work with the emission factors in lbs/hr) necessitated the development of the following assumptions for off-road sources:

- Four-wheeler activity noted as "all day" or "everyday" was assumed to be in operation for 4 hours/day; and

- Because Diesel grader activity in some surveys was expressed in terms of miles driven, hours of operation were estimated by assuming that graders are driven an average of 5 miles/hour.

Outdoor Refuse Burning

Emission factors in pounds per ton burned for refuse combustion were obtained from AP-42.[14] However, refuse burning activities (open or barrel burning) in the surveys were expressed in terms of hours burned, the metric by which residents could readily estimate burning frequency. There are no published estimates for the amount of refuse burned in an hour, nor is there an emission factor for $PM_{2.5}$ in AP-42. Because of these factors, the following assumptions were made in estimating emissions from refuse burning:

- An estimated 20 pounds of refuse is burned per hour based on anecdotal residential evidence; and

- $PM_{2.5}$ emissions from refuse combustion were assumed to be equivalent to the PM_{10} levels.

Outdoor Wood Burning

Outdoor wood burning for cook or camp fires and for smokehouses is commonplace in rural Alaska. Emission factors for these sources are assumed to be the same as those for wood combustion for heating purposes, which are in pounds of emissions per ton of wood burned. Survey responses, however, are given in terms of hours of cook or camp fire and hours of smokehouse use. As with refuse combustion, cook and camp fires and smokehouses are not all the same size and burn wood at different rates. After consulting with Alaska residents, the following assumptions were made:

- Cook and camp fires burn 4 split logs (16 pounds of wood) per hour; and

- An average smokehouse burns 60 pounds of wood per hour.

Fugitive Dust

One of the major sources of PM_{10} and $PM_{2.5}$ emissions in the state is fugitive dust from unpaved roadways typical in rural Alaska. Calculations for unpaved road emissions were based on the procedures in AP-42 for fugitive dust.[15] Alaska-specific factors were used as much as possible in the analysis, along with local precipitation data. Outlined below are the assumptions used in estimating emission factors and emissions of fugitive dust from unpaved roads in rural Alaska.

- A 15% surface material silt content was used based on samples collected on unpaved streets in the Mendenhall Valley for a 1988 PM_{10} inventory prepared by Engineering Science for EPA.[16]

- The soil moisture content was set at 1.1%—the average found for measured unpaved roads in Region 10.

- The average on-road vehicle speed on unpaved roadways was assumed to be 25 mph based on discussions with staff from the City of Fairbanks and the City and Borough of Juneau.

- The average four-wheeler speed was 15 mph based on a survey of ATV users for the motorcycle industry.[17]

- In order to account for the mitigating effect of precipitation, days with measurable precipitation were based on data from the Western Regional Climate Center for the community or the closest community available.[18]

- Fugitive dust was generated only during the summer months, as the ground is mostly icy and wet during the winter.

- Lacking evidence to the contrary, four-wheelers were assumed to generate as much fugitive dust per mile as on-road four-wheel vehicles.

- Gravel roads were assumed to generate half as much fugitive dust emissions as dirt roads.

The calculations outlined in AP-42 produce emission factors in units of pounds per vehicle miles traveled (VMT). After discussions with ADEC staff and contacts from the representative communities, estimates for the percentage of roadways that are unpaved in the community were developed. These are shown in Table 4-3. These percentages were applied to the total on- and off-road VMT estimated from the residential and non-residential survey responses to result in the total VMT on unpaved roads in the community.

Table 4-3
Unpaved Roads in Representative Communities[a]

Community	% Unpaved
Arctic Village	100%
Bethel	50%
Buckland	100% (gravel)
Dillingham	50%
Huslia	100%
Klawock	40%
Kongiganak	10%
Minto	100%
Northway Village	100%
Port Graham	100%
Sand Point	50%
Stebbins	100%

[a] Fugitive dust emissions for Sitka are included in the Juneau inventory used in developing the Sitka inventory.

Commercial Marine Vessels

An analysis of commercial marine vessels was performed separately from the survey data analysis and included all communities with ports and harbors that were not analyzed as part of the commercial marine inventory developed by Pechan for ADEC.[1] The Pechan analysis covered the nine largest ports in the state:

- Anchorage,
- Dutch Harbor,
- Homer,
- Nikiski,
- Juneau,
- Ketchikan,
- Kivalina,
- Kodiak, and
- Valdez.

Activity for the smaller ports and harbors in Alaska was estimated using data from published schedules, route lists, and registration records for four main vessel types: cruise ships, ferries, tugs, and fishing vessels. Container and cargo ships were considered for the analysis; however, these vessels were found to dock only at the larger ports previously analyzed by Pechan.

Vessel emissions were estimated in the Pechan analysis using emission factors for four engine modes, where applicable: cruising, reduced speed zone (RSZ), maneuvering, and hotelling. For all vessel types, the activity, time in engine mode, load factor (LF) per mode, average rated engine power, and emission factors (EF) were used in the following equation to estimate emissions for each mode of operation:

$$\text{Emissions}_{\text{mode}}\left(\frac{\text{tons}}{\text{season}}\right) = \frac{\text{calls}}{\text{season}} \times \frac{\text{hr}_{\text{mode}}}{\text{call}} \times \text{EF}_{\text{mode}}\left(\frac{\text{grams}}{\text{hp} - \text{hr}}\right) \times \text{RatedPower}(\text{hp}) \times \text{LF}_{\text{mode}} \times \frac{1\,\text{ton}}{907185\,\text{grams}}$$

The resulting emissions for each engine mode were then summed for the total emissions for the vessel for each season. Vessel emissions within 25 miles of the port were assumed to affect the community and were included in the total emissions. The additional assumptions and data sources used in the analysis are outlined below for each vessel type.

Cruise Ships – Twelve cruise ports were identified outside of the major ports previously analyzed by Pechan. The smaller ports found with cruise ship activity are listed in Table 4-4.

Table 4-4 Smaller Ports Found with Cruise Ship Activity	
Glacier Bay	Seward
Haines	Sitka
Hoonah/Icy Strait	Skagway
Metlakatla	Whitter
Petersburg	Wrangell
Point Sophia	

Cruise ship calls were estimated for Sitka using data for 2005 obtained from the harbormaster's office (220 port calls during the summer). For the rest of the cruise ports, total cruise ship calls were based on 2006 schedules from the Cruise Line Agencies of Alaska (CLAA) *(www.claalaska.com*). All cruise ship activity was found to be limited to the summer months. In addition to the scheduled cruise ship activity from the CLAA, activity from five cruise ships sailing once a day was added to the Whittier totals per the harbormaster's office.

For Sitka, the engine type distribution and times in the different engine modes were based on those used for Juneau in the Pechan analysis (3% Diesel 2-stroke, 79% Diesel 4-stroke, and 18% gas turbine) as similar ships dock at both ports. For the other cruise ports, the engine type distribution and times-in-mode were based on those found by Pechan for Kodiak (78% Diesel 2-stroke, 11% Diesel 4-stroke, and 11% gas turbine), which hosts more midsize cruise ships. Engine type-specific emission factors were based on those used by Pechan.

Ferries – Monthly ferry activity was derived from the Alaska Marine Highway System 2004 Annual Traffic Volume Report and the 2005/2006 schedules for the Inter-Island Ferry Authority for 29 ports not analyzed by Pechan. The 29 smaller ports found with ferry activity are shown in Table 4-5. The ferry average speed, times in mode, and emission factors were based on those used by Pechan for the analysis of the Kodiak Port.

Table 4-5 Smaller Ports with Ferry Activity			
Akutan	Haines	Port Lions	Tenakee
Angoon	Hollis	Sand Point	Unalaska
Chenega Bay	Hoonah	Seldovia	Whittier
Chignik	Kake	Seward	Wrangell
Coffman Cove	King Cove	Sitka	Yakutat
Cold Bay	Metlakatla	Skagway	
Cordova	Pelican	South Mitkof	
False Pass	Petersburg	Tatitlek	

Tugs – Tug activity was mostly derived from schedules and route lists for the three main barge service companies in Alaska:

- Northland Services Marine Transportation (NSMT);
- Alaska Marine Lines (AML) /Lynden Transport (LT); and
- Crowley Marine.

The City of Sand Point was not included in any of the published schedules and route list, but City personnel noted that the city had a regular barge service schedule of once every two weeks. Overall, a total of 104 community port and harbors not analyzed by Pechan were found to have tug traffic in Alaska. Barge service schedules for NSMT and AML/LT provided summer and winter activity for specific communities. However, Crowley Marine does not have published schedules, and activity was estimated as two calls per year during the summer for the communities in its route list. The tug average speed, times in mode, and emission factors were based on those used by Pechan for the analysis of the Kodiak Port.

Fishing Vessels – Fishing vessel activity was based on the average use per year found by Pechan for the fishing vessels in Kodiak applied to the total number of fishing vessels registered at each community. The 2005 fishing vessel registration data were obtained from the Alaska Commercial Fisheries Entry Commission (CFEC).[19] A total of 167 community ports and harbors not analyzed by Pechan was represented in the CFEC records.

Because the CFEC records provide no insight on the seasonal variation in fishing vessel activity, residents from representative community ports and harbormasters were contacted for an estimate on seasonal activity for each borough. Based on these discussions, the seasonal activity distributions shown in Table 4-6 were used. The engine fuel and vessel type distribution, vessel average speeds, times-in-mode, and emission factors were based on those used by Pechan for the analysis of the Kodiak Port.

Table 4-6
Seasonal Factors Assumed for Fishing Vessel Activity

Boroughs	Summer Fraction	Winter Fraction
Aleutians East and Aleutians West	80%	20%
Southeast Counties[a]	50%	50%
Other Counties	100%	0%

[a] Includes Haines, Juneau, Ketchikan Gateway, Prince of Wales-Outer Ketchikan, Sitka, Skagway-Hoonah-Angoon, Wrangell-Petersburg, and Yakutat

Filling in Missing Data and Incomplete Surveys

As shown in Table 3-2, not all surveys were completed for each representative community. After an exhaustive effort to collect as much data through surveys, limited resources necessitated the use of surrogates to fill the missing information. The following outlines how surrogate data sources were used to complete the emissions inventory for each representative community.

Bethel – No non-residential surveys were received for Bethel. The non-residential facilities originally targeted for activity and fuel use data include Bethel Utilities Corp., the municipal offices, landfill, wastewater treatment facility, Bethel schools, and the Yukon-Kuskokwim Delta Regional Hospital. Bethel Utilities Corp. is a major point source, and emissions data for the utility were obtained from ADEC. For the others, data on corresponding facilities from Dillingham were used (after completion as noted below). The seasonal fuel use and activity from the Dillingham non-residential surveys were adjusted using population to represent Bethel non-residential fuel use and activity.

Dillingham – No winter non-residential surveys were collected for Dillingham. Using the summer activity estimates year-round would fail to reflect the typical increase in fuel use (especially for heating) and decrease in vehicle and equipment use found during the winter months. Therefore, the seasonal trends found from surveys of Port Graham were applied to the Dillingham data. The following assumptions were made for non-residential facilities based on the Port Graham survey results:

- Twice as much heating fuel is used in the winter as compared to the summer;
- Total on-road vehicle VMT decreases by about 55% in the winter (actual decrease varies by facility);
- Four-wheelers (found at the school) are not used during the winter; and
- Off-road Diesel equipment use, refuse burning, and wastewater processing emissions did not vary by season.

Kongiganak – Eight separate non-residential surveys were sent to Kongiganak to survey the fuel use and activity at the airport, school and library, landfill, clinic, electric utility, Tribal Corporation, sewage treatment facility, and municipal offices. However, four residential surveys were received back from Kongiganak marked "commercial," but with no explanation as to which non-residential facilities they covered. Attempts at contacting the survey facilitators in Kongiganak to receive clarification on the surveys were unsuccessful. Because of the lack of facility specificity and the very limited responses in the surveys marked "commercial," the facility-specific non-residential information collected from Port Graham was adjusted based on population and applied to Kongiganak.

Minto – Only two non-residential surveys for the clinic and the school were completed for Minto, which left out the washeteria and water treatment plant, landfill, and city operations. For the missing facilities, the facility-specific fuel use and activity estimates from the Huslia non-residential surveys were used after adjusting for population.

Northway Village – Only a survey of the airport was completed for Huslia among the total of eight non-residential facilities identified for surveying. The missing survey results include those for Alaska Power Company (APC), municipal offices, fuel supplier, clinic, landfill, school, and wastewater treatment facility. Diesel fuel use estimates for power generation at APC, the main emission source at the facility, were derived from the 2005 PCE report. For the other facilities, results of the non-residential surveys from Huslia were used with adjustments based on population.

Sand Point – Although non-residential surveys were filled out for all relevant sources in Sand Point, some of the facilities, including Peter Pan Seafoods and TDX Power Corporation, did not return winter surveys. The seasonal fuel use and activity trends found in the completed surveys of the other facilities became the basis for the missing winter data. According to results of the surveys of the municipal offices, landfill and wastewater treatment facility, activity and fuel use at the non-residential facilities did not vary by season.

Stebbins – Only winter residential surveys were filled out for Stebbins. To estimate the summer residential data, estimates from Buckland were used. Where corresponding residential winter data were available for Buckland, the ratio of the summer to winter activity and fuel use from Buckland was applied to the winter activity found for Stebbins to estimate the summer residential levels. If winter activity or fuel use for a specific source was not available from Buckland (e.g., source-related question was left blank or answered with "don't know"), then the corresponding summer residential estimates for Buckland were used for Stebbins after adjusting for population. Lastly, if the summer information is unknown for Buckland, as was the case for motorcycle use, it was assumed that the activity level in Stebbins during the summer was at least the same as during the winter (there was actual motorcycle use in the winter).

For non-residential sources, total Diesel fuel used for electricity generation in Stebbins (by Alaska Village Electric Cooperative or AVEC) was derived from the 2005 PCE data, and activity and fuel use estimates for municipal offices were estimated by adjusting facility-specific results from Buckland. Based on the survey results from Buckland, other non-residential facilities were negligible sources of emissions.

Representative Community Inventories and Fuel Use

After filling in all the missing survey information, emission factors were applied, and emission inventories were completed for the 13 representative communities. Table 4-7 summarizes the 2005 survey-based residential and non-residential inventories for the representative communities (no commercial marine vessels and aviation sources).

Table 4-7
Representative Communities 2005 Survey-Based Emission Inventories
(Excludes Commercial Marine and Aviation)

Community	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Arctic Village	6,763	4,299	142	4,879	1,353	14	0
Bethel	35,055	30,271	4,318	15,988	5,601	201	9
Buckland	2,762	3,136	140	1,625	477	5	0
Dillingham	38,662	30,360	3,518	18,728	6,201	486	9
Huslia	816	1,685	92	2,149	445	7	0
Klawock	5,843	6,999	289	5,708	1,307	24	3
Kongiganak	3,897	4,011	133	523	411	8	0
Minto	2,970	2,384	153	2,852	728	9	0
Northway Village	1,946	1,356	181	1,445	408	5	0
Port Graham	518	397	55	763	163	1	0
Sand Point	176	800	1,452	3,252	528	154	1
Sitka	1,894	12,629	3,006	6,442	1,637	191	23
Stebbins	3,302	5,025	320	4,654	968	7	0
Community	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Arctic Village	9,114	6,562	165	920	918	17	0
Bethel	24,800	25,164	4,209	2,699	2,672	182	5
Buckland	1,425	3,091	106	93	91	3	0
Dillingham	14,592	16,918	2,731	1,533	1,521	390	3
Huslia	1,117	1,019	74	182	181	7	0
Klawock	2,203	2,353	183	219	218	15	2
Kongiganak	2	14	9	0	0	0	0
Minto	1,683	1,659	137	213	212	7	0
Northway Village	593	762	174	81	80	3	0
Port Graham	1,048	649	59	113	113	2	0
Sand Point	116	691	1,474	53	47	154	1
Sitka	1,618	12,327	2,909	2,359	702	197	23
Stebbins	6,744	3,990	219	706	706	12	0

The high levels of PM_{10} and $PM_{2.5}$ are attributed primarily to fugitive dust from unpaved roads. Fugitive dust emissions are significant even in Bethel, Dillingham, Klawock, and Sand Point, where unpaved roads make up 50% or less of the roadways in the communities. Emissions for Kongiganak are much lower because only 10% of its roads are unpaved. On the other hand, Port Graham, which has 100% of its roads unpaved, has relatively low fugitive dust emissions due to the low VMT estimates from residential and non-residential vehicle travel in the community.

Emissions of HC and CO in both summer and winter are mainly due to residential wood burning activities. Residential wood burning is used primarily for heat and to a lesser extent in cook or camp fires and smokehouses in all of the representative communities, with the exception of Sand Point. According to locals, firewood is not easily accessible in Sand Point, and fuel oil is used for heating year-round in the community. For Kongiganak, a complete shift from some wood use to all fuel oil is seen during the winter, resulting in much lower winter emissions than summer.

The estimated 2005 summer and winter residential fuel use in the representative communities is shown in Table 4-8. Values shown should be treated as minimum possible levels due to the limited responses received from the surveys on fuel use estimates. Estimates for fuel use were more readily available for heating purposes, but were seldom given for on- and off-road vehicles and off-road equipment. As mentioned above, the level of wood use correlates with the HC and CO emissions from each community. Since surveys were collected from as early as summer 2004, it is unclear how much fuel use levels are affected by recent price increases for fuel oil, gasoline, and Diesel. However, historically, increases in liquid fuel prices lead to increases in wood use, because wood is generally free and accessible.

The total 2005 emissions from commercial marine vessels for the communities are shown in Table 4-9. Arctic Village, Minto, and Northway Village did not have any commercial marine vessel activity. Most of the commercial marine vessel activity in the other communities occurs only during the summer when water routes are not frozen. Communities in the south and southeast such as Sand Point, Dillingham, Klawock, and Sitka, have commercial marine vessel activity year-round. Of the 13, Sitka has the highest levels of emissions from commercial marine vessels, most of which are from cruise ships. Sitka is the only one of the representative communities with cruise ship traffic. For the other communities, commercial fishing vessels are the primary contributors to their commercial marine vessel inventories.

The following section of this report outlines how the residential and non-residential inventories from the representative communities were extrapolated to the rest of the small and midsize communities in the state.

Table 4-8
2005 Residential Seasonal Fuel Use Estimates

Community	Summer Total Fuel Use				
	Wood (cords)	Fuel Oil (gal)	Propane (gal)	Gasoline (gal)	Diesel (gal)
Arctic Village	3,823	3,032	1,222	93,512	4,461
Bethel	6,981	458,028	8,562	1,281,650	63,894
Buckland	1,681	20,102	5,974	68,300	n/a
Dillingham	7,078	454,399	345,109	1,372,310	487,922
Huslia	81	18,577	0	40,997	0
Klawock	1,356	126,867	61,610	264,918	38,518
Kongiganak	1,798	13,670	0	55,169	4,681
Minto	222	20,738	480	46,389	512
Northway Village	487	13,392	48,667	21,576	0
Port Graham	159	17,096	14	8,312	290
Sand Point	n/a	133,583	0	165,400	23,651
Sitka	n/a	n/a	n/a	n/a	n/a
Stebbins	1,900	23,293	7,914	132,548	n/a
Community	Winter Total Fuel Use				
	Wood (cords)	Fuel Oil (gal)	Propane (gal)	Gasoline (gal)	Diesel (gal)
Arctic Village	5,650	3,328	615	46,954	3,311
Bethel	13,057	1,806,536	4,212	638,706	0
Buckland	472	50,930	4,125	37,054	n/a
Dillingham	7,078	590,358	1,238	636,454	7,661
Huslia	568	41,212	0	34,827	0
Klawock	1,294	241,159	71,662	219,833	32,036
Kongiganak	n/a	42,346	n/a	0	0
Minto	885	59,046	2,419	29,853	1,744
Northway Village	268	56,607	7,356	26,434	10,902
Port Graham	416	31,843	13	16,659	3,588
Sand Point	0	390,533	0	329,557	61,194
Sitka	n/a	n/a	n/a	n/a	n/a
Stebbins	4,438	58,188	439	42,196	0

Table 4-9
Representative Communities 2005 Commercial Marine Vessels
Emission Inventories

Community	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Arctic Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bethel	4.65	81.08	13.76	0.29	0.28	2.16	0.07
Buckland	0.00	0.06	0.32	0.01	0.01	0.09	0.00
Dillingham	10.26	100.01	153.20	4.52	4.38	35.53	0.15
Huslia	0.00	0.06	0.32	0.01	0.01	0.09	0.00
Klawock	1.60	21.59	18.08	0.50	0.48	4.24	0.02
Kongiganak	1.58	26.60	6.14	0.14	0.14	1.10	0.02
Minto	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Northway Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port Graham	0.79	10.47	7.30	0.21	0.20	1.60	0.01
Sand Point	9.71	109.25	143.93	4.09	3.96	34.31	0.15
Sitka	301.37	1,289.37	8,951.50	675.87	655.57	4,760.86	3.72
Stebbins	1.29	23.61	2.00	0.02	0.02	0.14	0.02
Community	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Arctic Village	0.00	1.00	2.00	3.00	4.00	5.00	6.00
Bethel	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Buckland	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dillingham	0.00	0.03	0.16	0.00	0.00	0.05	0.00
Huslia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Klawock	1.60	21.59	18.08	0.50	0.48	4.24	0.02
Kongiganak	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minto	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Northway Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port Graham	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand Point	2.48	28.23	40.86	1.14	1.11	9.99	0.04
Sitka	28.37	366.64	702.61	18.34	17.77	186.48	0.53
Stebbins	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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5. EXTRAPOLATING EMISSIONS STATEWIDE

Extrapolation Methodology

Discussions with ADEC indicate that the emission estimates resulting from the commercial marine vessel analysis performed, along with emission estimates from the Pechan analysis, already account for all possible commercial marine activity in the state. Likewise, a complete aviation and major point source (mainly power generation) emission inventory has already been developed for the entire state. Therefore, only emission estimates for survey-based sources were extrapolated to the rest of the small and midsize communities in Alaska. In addition, communities with major point sources were not allotted additional emissions from electric power generation.

Outside of the 13 representative communities and the communities in Anchorage, Fairbanks North Star and Juneau, a total of 325 small and 27 midsize communities need emission estimates through extrapolation. Note that communities within the boroughs of Anchorage, Fairbanks North Star, and Juneau were excluded from the analysis as inventories are already completed for these three boroughs. The first step in extrapolating the emissions from the representative communities to the rest of the small and midsize communities in the state was to designate common size and location and identify whether the community is on the main Alaska Highway System (AHS). Each community was designated as small or midsize depending on 2005 population,[20] with small communities having populations less than 2,000 and midsize communities having populations between 2,000 and 30,000.[*] Location within the state was indicated by the borough or census area where the community is located, as well as by the geographic region as defined in Figure 3-1. As a third designation, communities along the AHS were identified and distinguished from the other "off-highway" communities. Figure 5-1 shows the primary areas of the state served by the Alaska Highway System. They include the regions between Anchorage and Fairbanks and eastward to the Canadian border, the Kenai Peninsula south of Anchorage, and Juneau, Skagway, and Haines in the southeast. Table 5-1 shows the 13 representative communities with the designations outlined.

[*] Only the communities of Anchorage, Fairbanks and Juneau fall outside of the population scheme (as designed, since emissions for these communities are known) with 2005 populations of 278,241; 31,182; and 31,193, respectively.

Figure 5-1
Communities on the Alaska Highway System

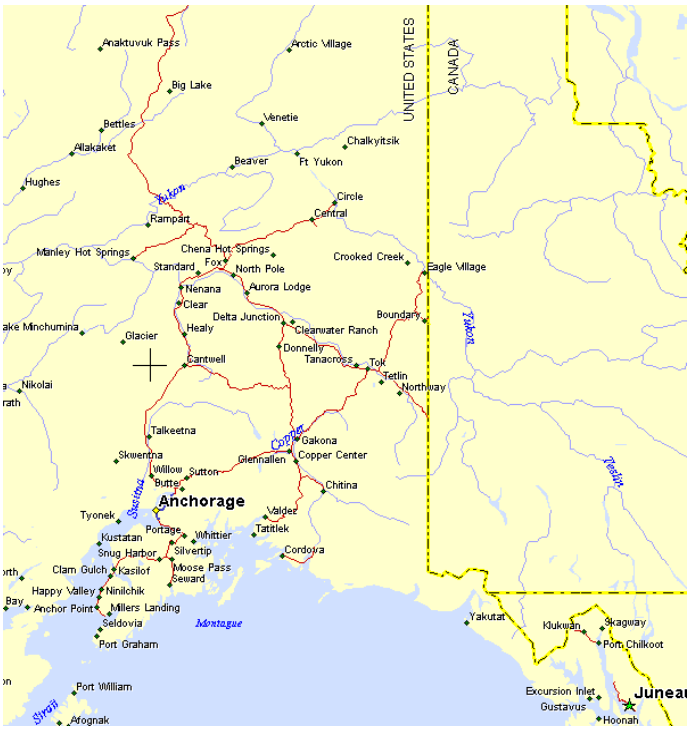

Table 5-1 Size, Location and Highway Designations of Representative Communities				
Community	Borough	Region	Population Group	On Highway
Sand Point	Aleutians East	Aleutians - Bristol Bay	Small	No
Dillingham	Dillingham	Aleutians - Bristol Bay	Midsize	Yes
Arctic Village	Yukon-Koyukuk	Rural Interior	Small	No
Huslia	Yukon-Koyukuk	Rural Interior	Small	No
Minto	Yukon-Koyukuk	Rural Interior	Small	Yes
Northway Village	Southeast Fairbanks	South Central	Small	No[a]
Port Graham	Kenai Peninsula	South Central	Small	No
Klawock	Prince of Wales	Southeast	Small	Yes
Sitka	Sitka	Southeast	Midsize	Yes
Buckland	Northwest Arctic	West Coast	Small	No
Kongiganak	Bethel	West Coast	Small	No
Stebbins	Nome	West Coast	Small	No
Bethel	Bethel	West Coast	Midsize	Yes

[a] Connected by unpaved road to highway system

In addition to the designations indicated, other unique criteria are needed for survey-based sources that are independent of size, location, and highway access within the community. These sources include power generation (electric utility) and residential boats (i.e., non-commercial marine). Since major point sources consist mainly of electric utility emissions and have already been analyzed and are included in inventories as previously noted, communities with major point sources were identified using ADEC permit records and marked to negate emissions from power generation. The same process was done for communities that use hydropower and for those located in areas that are on a power grid and would not have any electric utility emissions. The communities that were excluded from extrapolation of power generation emissions are listed in Table 5-2.

Table 5-2
Communities Excluded from Power Generation Emissions Extrapolation

Barrow	Kodiak
Cordova	Kotzebue
Delta Junction	Nenana
Healy	Nome
Ketchikan	North Pole
All Communities in Matanuska-Susitna (power grid)	

As an additional refinement to the extrapolation, communities that do not have access to bodies of water should be excluded from extrapolation of non-commercial boat emissions. In order to identify the communities with and without potential boat emissions, a database of boat registration information was obtained from the Alaska Division of Motor Vehicles (DMV). In the absence of any other source of boat activity indicators, communities with no boat registrations (per owner's address) were identified for exclusion from extrapolated boat emissions. Of the 352 small and midsize communities in the analysis, 106 did not have boats registered.

After all designations and exclusions were noted, a surrogate from the 13 representative communities was assigned to each community included in the extrapolation. Surrogates were assigned based on the following schema outlined by region:

- Aleutians-Bristol Bay – Sand Point was used to represent all small communities, and Dillingham was used for all midsize communities.

- North Slope – Since no representative community was analyzed in North Slope, Buckland was used to represent all communities in the region.

- West Coast - For small communities, surrogates were assigned by borough: Buckland for Northwest Arctic; Stebbins for Nome; and Kongiganak for Wade Hampton and the western part of Bethel borough. For all midsize communities in the region, Bethel was used as the surrogate.

- Rural Interior – Minto was used to represent all communities in the rural interior with highway access. For the communities with no highway access, Arctic Village was used as a surrogate for those with no boats registered, while Huslia was used for communities with registered boats.

- South Central – Northway Village was used to represent all the inland communities of Southeast Fairbanks, Denali, and Matanuska-Susitna. For the communities in the Kenai Peninsula and Valdez-Cordova counties, Port Graham was used as the surrogate.

- Southeast – For all small communities in the southeast, Klawock was used as the representative, and Sitka was used for all the midsize communities.

A listing of all the communities in Alaska—along with designations, assigned surrogates and exclusions—is provided in Appendix C. Population ratios were computed for each combination of community and surrogate (i.e., surrogate population ÷ community population), and the surrogate emissions from all sources except electric utility and boats were multiplied by the ratio to result in estimated community levels. Separately, electricity power generation emissions from the surrogate were multiplied by the community ratio if the community was not excluded from the power generation extrapolation (as listed in Table 5-2). Otherwise, emissions from power generation for the community were set to zero. Likewise, boat emissions from the surrogate, if any, were multiplied by the community ratio if the community was not excluded from the boat emission extrapolation. Resulting community emissions from all three calculations (electric utility, boat, and all else) are then summed over all communities in each borough.

Emission Inventories

The resulting 2005 summer and winter emission inventories by borough for all survey-based sources (which exclude commercial marine, major point sources, and aviation) are shown in Tables 5-3 and 5-4, respectively. The tables present the inventories by decreasing borough population for comparison.

It is difficult to see a clear picture of NOx levels for the boroughs when major point sources are excluded. Including point sources should increase emissions for some of the highly populated boroughs such as Valdez-Cordova, Kodiak Island, Nome, Ketchikan Gateway, Northwest Arctic, and North Slope. For PM_{10} and $PM_{2.5}$, the inventory is overwhelmed by fugitive dust emissions from unpaved roads in the summer. Summer

Table 5-3
Summer 2005 Survey-Based Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	2005 Population	Summer Emissions (lbs/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	67,210	1,308,550	872,910	30,529	979,336	275,682	3,587	132
Kenai Peninsula	51,133	571,980	443,022	68,589	340,587	102,212	8,704	141
Bethel	17,086	138,337	134,606	7,785	32,816	16,988	418	14
Valdez-Cordova	10,508	40,584	30,461	3,580	59,805	12,772	110	4
Kodiak Island	9,640	94,651	67,051	7,083	60,170	17,715	785	24
Nome	9,333	52,831	66,684	3,578	54,831	12,700	122	9
Sitka	8,947	1,894	12,629	3,006	6,442	1,637	191	23
Ketchikan Gateway	8,090	4,661	14,481	2,732	8,497	2,085	177	21
Wade Hampton	7,863	43,446	65,098	4,168	61,401	12,768	94	5
Northwest Arctic	7,094	45,131	51,095	2,043	26,554	7,797	89	3
North Slope	6,905	43,836	48,807	1,854	25,844	7,587	86	3
Southeast Fairbanks	6,379	124,852	85,845	10,227	93,090	26,283	341	13
Wrangell-Petersburg	5,848	6,425	13,507	1,984	8,953	2,143	132	16
Yukon-Koyukuk	5,679	42,904	48,892	2,369	60,202	13,881	193	5
Aleutians West	5,248	70,275	55,855	7,850	37,248	11,778	1,038	17
Prince of Wales	4,893	36,654	43,903	1,812	35,804	8,199	152	16
Dillingham	4,746	39,108	32,384	7,193	26,957	7,538	876	12
Skagway-Angoon	3,029	22,552	26,636	1,105	22,162	5,073	94	10
Aleutians East	2,657	499	2,264	4,110	9,202	1,495	436	3
Haines	2,125	15,317	16,710	715	15,538	3,550	65	7
Denali	1,951	38,300	26,333	2,182	28,457	8,027	104	4
Lake & Peninsula	1,598	300	1,362	2,472	5,535	899	262	2
Bristol Bay	1,073	201	914	1,660	3,716	604	176	1
Yakutat	619	4,637	5,554	229	4,529	1,037	19	2
All Rural Communities	249,654	2,747,926	2,167,005	178,854	2,007,676	560,449	18,253	488

Table 5-4
Winter 2005 Survey-Based Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	2005 Population	Winter Emissions (lbs/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	67,210	400,276	492,766	25,914	53,216	52,912	2,229	205
Kenai Peninsula	51,133	255,028	278,727	59,740	27,416	27,150	7,575	59
Bethel	17,086	29,909	29,264	4,555	3,256	3,227	201	6
Valdez-Cordova	10,508	82,195	50,673	3,981	8,856	8,846	179	4
Kodiak Island	9,640	37,746	45,042	6,483	4,034	3,995	691	11
Nome	9,333	80,451	53,715	2,526	8,422	8,411	157	4
Sitka	8,947	1,618	12,327	2,909	2,359	702	197	23
Ketchikan Gateway	8,090	2,534	11,810	2,594	2,140	716	177	21
Wade Hampton	7,863	88,976	52,634	2,883	9,315	9,308	156	1
Northwest Arctic	7,094	23,284	50,466	1,489	1,514	1,489	48	6
North Slope	6,905	22,661	49,097	1,359	1,472	1,448	46	6
Southeast Fairbanks	6,379	38,197	48,713	9,778	5,182	5,132	212	19
Wrangell-Petersburg	5,848	2,958	9,236	1,836	1,555	603	127	15
Yukon-Koyukuk	5,679	47,555	39,800	2,054	6,141	6,121	189	2
Aleutians West	5,248	26,574	31,373	6,445	2,833	2,804	862	7
Prince of Wales	4,893	13,821	14,761	1,147	1,377	1,369	97	13
Dillingham	4,746	14,885	18,666	6,462	1,667	1,638	779	5
Skagway-Angoon	3,029	8,556	9,138	710	852	848	60	8
Aleutians East	2,657	328	1,955	4,172	150	132	435	2
Haines	2,125	6,002	6,411	498	598	595	42	5
Denali	1,951	11,656	14,647	2,041	1,568	1,555	65	6
Lake & Peninsula	1,598	197	1,176	2,509	90	79	262	1
Bristol Bay	1,073	132	790	1,685	60	53	176	1
Yakutat	619	1,748	1,867	145	174	173	12	2
All Rural Communities	249,654	1,197,287	1,325,054	153,917	144,246	139,308	14,974	431

emissions of HC and CO also stand out for Matanuska-Susitna, Southeast Fairbanks, and Denali. The notable levels are mainly due to the prevalence of wood burning found in Northway Village, the surrogate for all three boroughs. During the winter, however, wood use decreases and fuel oil use increases, which is reflected in the lower emissions for the season. A similar trend is found for the borough of Bethel, where a complete shift from some wood use to all fuel oil is seen for the winter, resulting in much lower winter emissions than summer (Kongiganak-based).

Wood burning also affects emissions for Prince of Wales, Haines, and Yakutat, along with slightly elevated summer CO levels from motorized boat use reflecting activity trends in Klawock. On the other hand, boroughs with emissions derived mainly from Sand Point—including Aleutians East, Lake and Peninsula, and Bristol Bay—reflect no wood burning at all. According to locals, firewood is not easily accessible in Sand Point as the main vegetation is brush weed; therefore, fuel oil is mainly used for heating in the area. Low HC levels can also be seen for Sitka, Ketchikan Gateway, and Wrangell-Petersburg—all from the estimated levels for the community of Sitka.

Table 5-5 shows a comparison of the total emissions from the Municipality of Anchorage (MOA), Fairbanks North Star Borough (FNSB), Juneau, and the total for the other boroughs included in this study. Emissions for MOA, FNSB, and Juneau were based on the most recent inventories prepared for the boroughs for 2002,[21] which provide estimates sufficient for a quick comparison with the 2005 estimates for the rest of the state. Because of the prevalence of wood burning, emissions from rural Alaska make up over 95% of the HC emissions and over 65% of the CO emissions in the state, in spite of being residence to only 38% of the population. Mostly because of fugitive dust from unpaved roads (and partly due to wood burning), PM_{10} and $PM_{2.5}$ emissions from rural Alaska make up about 80% of the state total.

The total 2005 commercial marine vessel emission inventories for each borough, excluding emissions from the 9 largest ports, are shown in Tables 5-6 and 5-7 for summer and winter, respectively. With the exception of the southeast where commercial marine vessel traffic outside of cruise ships is constant year-round, commercial marine emissions are significantly higher during the summer months. Table 5-8 summarizes the statewide emissions by vessel type for the smaller ports and harbors and shows which vessel types contribute the most to the emission inventories. The highest HC and CO emissions come from the fishing vessels for both seasons. However, the NOx inventory is dominated by emissions from cruise ships during the summer (with activity concentrated in the southeastern portion of the state) and by ferries during the winter.

Table 5-9 compares the total seasonal emissions from the smaller ports and harbors to the total seasonal inventory for the nine largest ports in the state. Emissions for the nine largest ports were based on 2002 inventories for which seasonal data were available. As shown, the commercial marine inventory for the smaller ports and harbors makes up about 50% of the statewide summer emission inventory and about 20% of the winter total.

Table 5-5
Seasonal Emission Inventories for Alaska[a]
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	2005 Population	Summer Emissions (tons/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Municipality of Anchorage	310,474	21	168	14	63	18	1	1
Fairbanks North Star	54,934	29	477	15	105	47	3	2
Juneau	36,275	4	32	6	12	3	0	0
All Other Boroughs	249,654	1,374	1,084	89	1,004	280	9	0
TOTAL	651,337	1,428	1,761	125	1,183	347	13	3
Borough	2005 Population	Winter Emissions (tons/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Municipality of Anchorage	310,474	7	89	10	28	6	0	0
Fairbanks North Star	54,934	8	65	6	50	8	0	0
Juneau	36,275	4	33	6	4	1	0	0
All Other Boroughs	249,654	599	663	77	72	70	7	0
TOTAL	651,337	618	849	99	154	85	8	1

[a] The most recent 2002 inventories were used for the Municipality of Anchorage, Fairbanks North Star, and Juneau for comparison purposes.

Table 5-6
2005 Summer Commercial Marine Vessel Emission Inventories by Borough
(Excludes 9 Largest Ports)

Borough	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	18.7	224.9	308.0	8.5	8.2	76.1	0.3
Aleutians West	3.5	43.4	59.8	1.6	1.6	14.9	0.1
Anchorage	6.4	88.6	52.9	1.5	1.4	11.4	0.1
Bethel	60.4	1,069.6	154.6	2.9	2.8	22.2	0.9
Bristol Bay	8.3	105.3	86.8	2.5	2.4	19.5	0.1
Dillingham	37.6	537.0	290.8	8.0	7.8	62.2	0.6
Fairbanks North Star	3.3	47.1	26.4	0.7	0.7	5.7	0.0
Haines	57.8	379.8	2,504.8	123.5	119.8	960.0	0.9
Juneau	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenai Peninsula	66.2	724.4	1,363.9	59.5	57.7	459.2	1.0
Ketchikan Gateway	1.4	16.3	17.1	0.5	0.5	3.9	0.0
Kodiak Island	8.7	126.7	135.7	3.5	3.4	34.7	0.1
Lake & Peninsula	15.2	202.2	161.2	4.5	4.3	37.0	0.2
Matanuska-Susitna	10.5	134.9	105.6	3.0	2.9	23.5	0.2
Nome	14.8	256.4	46.0	1.0	0.9	7.5	0.2
North Slope	0.1	2.5	0.8	0.0	0.0	0.2	0.0
Northwest Arctic	1.5	26.6	5.6	0.1	0.1	1.1	0.0
Prince of Wales	35.9	384.2	1,260.6	49.6	48.1	424.7	0.7
Sitka	301.4	1,289.5	8,952.5	675.9	655.6	4,761.1	3.7
Skagway-Angoon	378.6	1,856.3	13,674.3	826.6	801.8	5,841.5	4.6
Southeast Fairbanks	0.8	6.8	13.6	0.4	0.4	3.2	0.0
Valdez/Cordova	459.5	2,418.5	15,376.4	946.7	918.3	6,613.7	5.5
Wade Hampton	23.0	419.4	41.8	0.6	0.5	4.2	0.4
Wrangell-Petersburg	108.8	962.7	4,012.5	177.2	171.8	1,433.5	1.8
Yakutat	6.9	114.6	70.9	1.7	1.7	17.7	0.1
Yukon-Koyukuk	2.2	38.2	18.1	0.4	0.4	4.4	0.0
TOTAL	1,631.7	11,475.8	48,740.7	2,900.5	2,813.2	20,843.1	21.7

Table 5-7
2005 Winter Commercial Marine Vessel Emission Inventories by Borough
(Excludes 9 Largest Ports)

Borough	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	4.8	59.0	91.4	2.5	2.4	23.2	0.1
Aleutians West	0.9	11.5	18.3	0.5	0.5	4.7	0.0
Anchorage	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bethel	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bristol Bay	0.0	0.1	0.3	0.0	0.0	0.1	0.0
Dillingham	0.0	0.1	0.3	0.0	0.0	0.1	0.0
Fairbanks North Star	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Haines	9.3	129.3	622.1	15.5	15.0	177.0	0.3
Juneau	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenai Peninsula	3.2	53.9	281.2	6.9	6.7	81.3	0.1
Ketchikan Gateway	1.4	16.3	17.1	0.5	0.5	3.9	0.0
Kodiak Island	0.7	12.3	64.3	1.6	1.5	18.6	0.0
Lake & Peninsula	0.1	1.7	9.0	0.2	0.2	2.6	0.0
Matanuska-Susitna	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nome	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Slope	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northwest Arctic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prince of Wales	21.9	314.6	728.3	18.4	17.8	200.8	0.5
Sitka	28.4	366.6	702.6	18.3	17.8	186.5	0.5
Skagway-Angoon	25.1	388.6	1,446.8	35.7	34.6	412.1	0.7
Southeast Fairbanks	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Valdez/Cordova	3.0	50.0	261.2	6.4	6.2	75.5	0.1
Wade Hampton	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wrangell-Petersburg	48.5	653.0	1,678.6	42.8	41.4	461.0	1.0
Yakutat	6.5	107.2	32.2	0.8	0.8	6.5	0.1
Yukon-Koyukuk	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	153.9	2,164.1	5,953.7	150.1	145.4	1,653.7	3.5

Table 5-8
2005 Seasonal Commercial Marine Vessel Emission Inventory by Vessel Type
(Excludes 9 Largest Ports)

Vessel Type	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Tugs	2	28	155	4	4	45	0
Fishing Vessels	389	5,575	2,964	82	79	631	6
Ferries	76	1,278	6,662	163	158	1,926	3
Cruise Ships	1,164	4,595	38,959	2,652	2,572	18,241	13
Vessel Type	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	PM2.5	SOx	NH_3
Tugs	1	17	92	2	2	26	0
Fishing Vessels	98	1,219	1,021	29	28	228	1
Ferries	55	929	4,841	118	115	1,399	2
Cruise Ships	0	0	0	0	0	0	0

Table 5-9
Statewide Seasonal Commercial Marine Vessel Emission Inventories

Ports	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Smaller Ports & Harbors	1,644	11,476	48,926	2,905	2,817	20,843	22
9 Largest Ports[a]	1,558	10,969	51,738	3,359	3,258	24,931	24
STATEWIDE TOTAL	3,202	22,445	100,664	6,264	6,075	45,774	46
Ports	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Smaller Ports & Harbors	157	2,164	6,028	152	147	1,654	4
9 Largest Ports[a]	571	7,017	18,459	949	921	7,993	11
STATEWIDE TOTAL	728	9,181	24,487	1,101	1,068	9,647	14

[a] Emissions based on 2002 seasonal inventory.

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6. 2018 INVENTORY PROJECTION

Overview

The 2005 rural communities and commercial marine vessel inventories were projected to 2018 using factors to account for changes in activity levels and changes in emission factors. The overall approach follows the equation

(2018 Level) = (2005 Level)* (Activity Factor)*(Emission Adjustment Factor),

where the activity factor accounts for the projected increase or decrease in activity between 2005 and 2018, and the emission adjustment factor reflect the change in source emission factors from 2005 to 2018. The development of the 2018 emission inventories mirrored the process used in the development of the 2005 inventories in that the following steps were taken:

- The 2005 inventories for the representative communities were projected to 2018 using the equation given above;
- The 2018 inventories were extrapolated to the rest of the state using the same representative community assignments (weighted using 2018 populations) used for extrapolating the 2005 inventories statewide; and
- The 2018 commercial marine vessel inventories were developed separately from the 2005 commercial marine vessel inventories using vessel-specific growth factors and estimated changes in emission factors derived from the analysis of the larger ports in Alaska.

How the activity and emission adjustment factors were developed for each representative community and emission source is discussed in further detail below.

Projected Activity Levels

In the absence of additional data on forecasted activity in the rural communities, the increase or decrease in emissions-related activity levels was assumed to be proportional to the change in population. In order to estimate 2018 populations, the average annual population growth or decline found between the 2000 census-derived population and the

2005 demographer-estimated population was extrapolated to 2018 for each rural community. The estimated annual average population changes and the 2018 populations for the 13 representative communities are shown in Table 6-1, along with the totals for all rural communities (outside of the boroughs of Anchorage, Fairbanks and Juneau). As shown, some of the communities were projected to increase in population, while others were projected to decrease. Overall, however, an annual average population growth of 2.1% was estimated for all rural communities. Activity factors used in projecting the 2005 activity to 2018 were calculated for each representative community by dividing the 2018 population by the 2005 population.

Table 6-1
Population Trends and 2018 Forecast

Community	2005 Population	2000-2005 Avg Annual Change	2018 Population	2018 Activity Factor
Arctic Village	147	-0.7%	135	0.92
Bethel	5,960	1.7%	7,446	1.25
Buckland	434	1.3%	516	1.19
Dillingham	2,370	-0.8%	2,138	0.90
Huslia	265	-2.0%	204	0.77
Klawock	780	-1.8%	616	0.79
Kongiganak	427	3.5%	670	1.57
Minto	202	-4.8%	107	0.53
Northway Village	99	-1.5%	81	0.82
Port Graham	134	-4.8%	71	0.53
Sand Point	939	-0.3%	906	0.96
Sitka	8,947	0.3%	9,245	1.03
Stebbins	596	1.7%	745	1.25
All Rural Communities	249,654	2.1%	325,959	n/a

For commercial marine activity at the smaller ports and harbors, activity growth factors were derived from the Pechan analysis of the nine largest ports in Alaska.[1] These factors were based on historic growth trends, passenger forecasts, discussions with the Southeast Alaska Marine Pilots Association, and population forecasts, and were developed for each vessel type included in the analysis. Table 6-2 summarizes the activity growth factors used in forecasting the 2005 commercial marine vessel inventories in Alaska to 2018.

Table 6-2 Commercial Marine Vessel Activity Growth Factors		
Vessel Type	Engine/Fuel Type	2018 Growth Factors
Cruise Ships	Diesel	1.96
	Gas Turbine	1.00
Fishing Vessels	Gasoline and Diesel[a]	1.44
Ferries	Diesel	1.14
Tugs	Diesel	1.14

[a] Based on gasoline-only growth factors from Pechan report.

After the inventories for the representative communities were adjusted for changes in activity levels, they were further adjusted to account for the changes in emission levels for various sources by applying emission adjustment factors. Note that activity factors and emission adjustment factors were directly applied only to the inventories of the representative communities. The inventories for the rest of the rural communities were based on the population-adjusted representative communities after a surrogate community is assigned to each rural community according to the scheme outlined in Section 5 and used in extrapolating the 2005 representative communities' inventories to the entire state.

Changes in Emission Factors

No change in area source emission factors is expected between 2005 and 2018. Therefore, the emission adjustment factor in the equation above was assumed to be 1 for area source emissions. However, due to vehicle or engine turnover to newer models and future engine and fuel standards, average emission levels for on-road vehicles, off-road vehicles and equipment, and commercial marine vessels in 2018 are expected to be lower than those from 2005. Emission adjustment factors were developed for the on- and off-road mobile sources using the ratio of the 2018 to 2005 emission factors (EFs) estimated using the EPA's MOBILE and NONROAD models. For 2018, a shift from the use of high-sulfur Diesel fuel (at 3,000 ppm sulfur) to ultra-low sulfur Diesel (ULSD) with 15 ppm sulfur is seen for both on- and off-road engines. In addition, low-sulfur gasoline fuel (average of 15 ppm and max of 30 ppm) for on-road vehicles is phased in starting in 2007 in Alaska. Other 2018 MOBILE and NONROAD model inputs remained unchanged from the 2005 model runs.

Table 6-3 shows the seasonal emission adjustment factors (2018 EFs ÷ 2005 EFs) found for on-road vehicles using MOBILE. Because the rural emissions inventory was mostly extrapolated statewide by EPA source category code (SCC), the factors were developed for the same vehicle groupings. The Sitka-based inventory was not available by SCC; therefore, the average fleet emissions adjustment factors were applied to the total on-road mobile emissions inventory for the community. Table 6-4 shows the 2018 emission adjustment factors estimated using NONROAD for the off-road vehicles and equipment used in the rural communities. As shown in Tables 6-3 and 6-4, significant decreases in

Table 6-3
Emissions Adjustment Factors for Projecting 2005 On-Road Mobile Emissions to 2018

Summer Adjustment Factors							
SCC Group	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Light Duty Gasoline Vehicles	0.30	0.56	0.28	0.98	0.97	0.19	1.00
Light Duty Gasoline Trucks 1 & 2	0.34	0.48	0.33	0.95	0.91	0.19	1.03
Light Duty Gasoline Trucks 3 & 4	0.34	0.50	0.38	0.93	0.89	0.19	1.03
Light Duty Diesel Trucks 1 thru 4	0.18	0.26	0.14	0.18	0.13	0.01	1.00
Motorcycles	0.98	1.00	1.00	1.00	1.00	0.19	1.00
All Heavy Duty Diesel Vehicles	0.44	0.20	0.24	0.22	0.17	0.00	1.00
All Heavy Duty Gasoline Vehicles	0.40	0.48	0.16	0.40	0.32	0.19	1.00
Vehicle Fleet Average	0.34	0.53	0.30	0.52	0.38	0.04	1.01
Winter Adjustment Factors							
SCC Group	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Light Duty Gasoline Vehicles	0.31	0.62	0.28	0.99	0.97	0.19	1.00
Light Duty Gasoline Trucks 1 & 2	0.31	0.48	0.31	0.95	0.92	0.19	1.02
Light Duty Gasoline Trucks 3 & 4	0.32	0.52	0.36	0.95	0.91	0.19	1.03
Light Duty Diesel Trucks 1 thru 4	0.21	0.29	0.14	0.21	0.15	0.01	1.00
Motorcycles	0.97	1.00	1.00	1.00	1.00	0.19	1.00
All Heavy Duty Diesel Vehicles	0.45	0.20	0.25	0.21	0.17	0.00	1.00
All Heavy Duty Gasoline Vehicles	0.32	0.46	0.17	0.40	0.32	0.19	1.00
Vehicle Fleet Average	0.34	0.55	0.30	0.52	0.38	0.04	1.01

SOx and Diesel PM emissions are seen due to the shift to ULSD and low-sulfur gasoline. Further emission reductions are seen for HC, CO, NOx, and PM from engine turnover to newer and cleaner engines that are subject to more stringent emission standards.

For commercial marine vessels (CMVs), 2018 changes in emission levels were estimated as part of the Pechan analysis of the nine largest ports in the state. Projected emission factors reflect future EPA regulation of Category 1, 2, and 3 vessel engines, and the use of low-sulfur Diesel fuel. The emission adjustment factors for each vessel type applied to estimate 2018 levels from the 2005 inventory are shown in Table 6-5. In assigning emissions adjustment factors for CMVs, the following assumptions were made:

- Emission reductions for propulsion engines for ferries and tugs reflect reductions for Category 2 engines;
- Auxiliary engines for ferries and tugs and fishing vessel engines reflect emission reductions expected for Category 1 engines; and
- Emission reductions for cruise ships were those estimated for Category 3 engines.

The bulk of emission reductions expected for CMVs in 2018 are for SOx due to the use of low-sulfur Diesel fuel.

Table 6-4
Emissions Adjustment Factors for Projecting 2005 Off-Road Equipment Emissions to 2018

Off-Road Equipment	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
2-Stroke Snowmobiles	0.47	0.56	2.96	0.61	0.61	0.96	1.00
4-Stroke Snowmobiles	0.47	0.56	2.96	0.61	0.61	0.96	1.00
2-Stroke All Terrain Vehicles	0.22	0.87	1.61	0.22	0.22	1.73	1.00
4-Stroke All Terrain Vehicles	0.72	0.91	0.68	1.01	1.01	1.01	1.00
Chain Saws < 6 HP (Residential)	0.32	0.74	1.47	0.89	0.89	1.03	1.00
2-Stroke Snowblowers (Residential)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4-Stroke Snowblowers (Residential)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2-Stroke Trimmers/Edgers/Brush Cutters (Residential)	0.31	0.68	1.43	0.91	0.91	1.05	1.00
4-Stroke Trimmers/Edgers/Brush Cutters (Residential)	0.36	0.97	0.51	0.49	0.49	0.91	1.00
2-Stroke Generator Sets	0.56	0.88	1.14	0.95	0.95	1.02	1.00
4-Stroke Generator Sets	0.61	1.03	0.79	0.79	0.79	0.93	1.00
Diesel Generator Sets	0.43	0.50	0.59	0.41	0.41	0.01	1.00
2-Stroke Pumps	0.77	0.93	1.04	0.99	0.99	1.01	1.00
4-Stroke Pumps	0.45	0.98	0.59	0.65	0.65	0.94	1.00
Diesel Pumps	0.46	0.52	0.58	0.42	0.42	0.01	1.00
2-Stroke Lawnmowers (Residential)	0.36	0.97	0.52	0.50	0.50	0.91	1.00
4-Stroke Lawnmowers (Residential)	0.36	0.97	0.52	0.50	0.50	0.91	1.00
Diesel Plate Compactors	0.47	0.79	0.60	0.43	0.43	0.01	1.00
Diesel Tractors/Loaders/Backhoes	0.38	0.47	0.47	0.44	0.44	0.01	1.00
Diesel Excavators	0.40	0.22	0.22	0.18	0.18	0.01	1.00
2-Stroke Outboard	0.47	0.71	1.74	0.44	0.44	0.98	1.00
4-Stroke Outboard	0.75	0.72	1.23	1.00	1.00	0.94	1.00
4-Stroke Inboard/Sterndrive	0.75	0.72	1.23	1.00	1.00	0.94	1.00
Diesel Inboard/Sterndrive	0.76	0.99	0.82	0.84	0.84	1.00	1.00
Tractors/Loaders/Backhoes	0.90	1.00	0.85	0.97	0.97	0.98	1.00
2-Stroke Logging Equipment (Chain Saws > 6 HP)	0.55	0.88	0.65	1.00	1.00	0.94	1.00
4-Stroke Logging Equipment (Shredders > 6 HP)	0.62	1.04	0.81	0.82	0.82	0.90	1.00
Diesel Logging Equipment (Forest Eqp - Feller/Bunch/Skidder)	0.41	0.19	0.17	0.12	0.12	0.00	1.00
Diesel Graders	0.41	0.25	0.21	0.20	0.20	0.01	1.00
Diesel Scrapers	0.46	0.31	0.28	0.26	0.26	0.01	1.00

Table 6-5 Emissions Adjustment Factors for Projecting 2005 CMV Inventory to 2018								
Vessel Type	Engine	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Ferries and Tugs	Propulsion	1.00	1.00	0.80	0.88	0.88	0.02	1.00
	Auxiliary	0.81	1.00	0.77	0.65	0.65	0.02	1.00
Cruise Ships		1.00	1.00	0.85	0.88	1.00	0.02	1.00
Fishing Vessels		0.81	1.00	0.77	0.65	0.65	0.02	1.00

Emission Inventories

The projected 2018 summer and winter emission inventories by borough for all survey-based sources (which exclude commercial marine, major point sources, and aviation) are shown in Tables 6-6 and 6-7, respectively. The tables present the inventories in the same order as the 2005 emission inventories in Tables 5-3 and 5-4 for comparison. The emission inventory changes between 2005 and 2018 are generally proportional to the changes in population. Emissions from on- and off-road vehicles and equipment are lower on average in 2018 as compared to 2005 due to turnover to newer engines that meet more stringent emission standards and the reduction of sulfur in both gasoline and Diesel fuel. However, projected emissions of HC, CO, and PM from wood combustion and fugitive dust still dominate the emissions inventory in 2018.

The projected 2018 summer and winter CMV inventories for the smaller ports and harbors in Alaska are shown in Tables 6-8 and 6-9, respectively. Emissions of SOx are actually lower in 2018 as compared to 2005 due to the use of low-sulfur Diesel fuel.

Table 6-6
Summer 2018 Survey-Based Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	2018 Population	Summer Emissions (lbs/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	123,616	2,388,092	1,567,093	54,337	1,801,018	506,848	6,487	245
Kenai Peninsula	62,487	724,502	539,103	83,092	427,227	130,318	10,837	183
Bethel	20,738	159,127	141,247	10,111	37,593	19,944	492	17
Valdez-Cordova	12,104	46,414	33,173	4,276	68,881	14,702	106	5
Kodiak Island	9,177	84,633	58,725	6,929	55,932	16,239	765	23
Nome	10,258	55,320	63,328	4,427	61,969	14,154	128	10
Sitka	9,245	1,957	13,049	3,106	6,656	1,692	198	24
Ketchikan Gateway	7,446	3,816	12,258	2,430	7,465	1,831	153	19
Wade Hampton	9,834	52,048	68,463	5,736	76,754	15,932	114	7
Northwest Arctic	7,612	47,010	47,529	2,480	28,471	8,346	95	3
North Slope	5,887	36,283	35,887	1,780	22,014	6,452	73	2
Southeast Fairbanks	8,753	169,647	114,490	13,339	127,703	36,036	460	17
Wrangell-Petersburg	4,869	4,740	9,751	1,577	7,174	1,712	98	13
Yukon-Koyukuk	5,457	45,349	45,172	2,330	60,486	14,190	191	6
Aleutians West	4,986	68,295	52,077	7,269	36,454	11,659	989	17
Prince of Wales	4,117	28,221	30,555	1,443	30,071	6,849	68	14
Dillingham	4,523	33,991	27,151	6,717	25,125	6,909	818	11
Skagway-Angoon	2,812	19,211	20,478	963	20,542	4,678	46	10
Aleutians East	2,627	389	1,864	3,987	9,095	1,474	420	3
Haines	3,880	25,161	20,508	892	28,315	6,431	58	12
Denali	2,980	57,863	39,255	3,987	43,472	12,263	157	6
Lake & Peninsula	1,475	218	1,047	2,239	5,107	828	236	2
Bristol Bay	764	113	542	1,159	2,643	428	122	1
Yakutat	310	2,122	2,298	109	2,262	515	5	1
All Rural Communities	325,959	4,054,524	2,945,043	224,715	2,992,428	840,429	23,114	651

Table 6-7
Winter 2018 Survey-Based Emission Inventories by Borough
(Excludes Point Sources, Commercial Marine, and Aviation)

Borough	2018 Population	Winter Emissions (lbs/day)						
		HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Matanuska-Susitna	123,616	676,585	737,065	43,724	96,745	96,268	3,567	381
Kenai Peninsula	62,487	292,316	288,475	72,934	33,850	33,560	9,369	75
Bethel	20,738	30,443	27,021	5,565	3,564	3,533	230	7
Valdez-Cordova	12,104	94,347	57,551	4,663	10,189	10,178	186	5
Kodiak Island	9,177	30,624	32,516	6,518	3,603	3,569	683	11
Nome	10,258	89,442	56,728	2,867	9,485	9,477	173	4
Sitka	9,245	1,672	12,738	3,006	2,438	725	204	24
Ketchikan Gateway	7,446	2,163	10,326	2,298	1,908	634	154	19
Wade Hampton	9,834	110,966	65,452	3,607	11,642	11,634	194	1
Northwest Arctic	7,612	18,432	34,501	3,336	1,512	1,495	49	6
North Slope	5,887	14,251	26,661	2,513	1,168	1,155	38	5
Southeast Fairbanks	8,753	48,174	54,705	12,562	7,020	6,958	253	27
Wrangell-Petersburg	4,869	2,280	7,153	1,457	1,256	485	96	12
Yukon-Koyukuk	5,457	44,722	36,180	1,976	5,907	5,890	180	3
Aleutians West	4,986	24,037	25,007	6,014	2,794	2,770	814	7
Prince of Wales	4,117	10,989	10,236	756	1,145	1,140	31	11
Dillingham	4,523	12,087	13,601	6,150	1,491	1,465	731	5
Skagway-Angoon	2,812	7,507	6,993	517	782	779	21	7
Aleutians East	2,627	293	1,612	4,053	144	126	420	2
Haines	3,880	10,357	9,648	713	1,079	1,074	29	10
Denali	2,980	16,386	18,476	3,712	2,380	2,361	86	9
Lake & Peninsula	1,475	165	905	2,276	81	71	236	1
Bristol Bay	764	85	469	1,178	42	37	122	1
Yakutat	310	826	770	57	86	86	2	1
All Rural Communities	325,959	1,539,148	1,534,789	192,454	200,310	195,468	17,865	634

Table 6-8
2018 Summer Commercial Marine Vessel Emission Inventories by Borough
(Excludes 9 Largest Ports)

Borough	Summer Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	22.5	317.9	332.6	8.3	8.0	2.4	0.4
Aleutians West	4.3	61.2	63.9	1.6	1.5	0.5	0.1
Anchorage	7.7	127.6	61.8	1.4	1.4	0.4	0.1
Bethel	72.9	1,538.8	173.0	2.8	2.7	0.7	1.3
Bristol Bay	10.0	151.5	100.4	2.4	2.3	0.7	0.2
Dillingham	45.5	773.2	338.8	7.8	7.6	2.1	0.8
Fairbanks North Star	4.0	67.8	30.8	0.7	0.7	0.2	0.1
Haines	101.1	583.9	3,434.4	193.9	188.0	39.7	1.4
Juneau	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenai Peninsula	92.4	1,059.5	1,800.8	87.0	84.3	18.5	1.5
Ketchikan Gateway	1.7	23.5	20.0	0.5	0.5	0.1	0.0
Kodiak Island	10.5	178.1	138.6	3.4	3.3	1.0	0.2
Lake & Peninsula	18.3	289.8	181.9	4.4	4.2	1.2	0.3
Matanuska-Susitna	12.7	194.2	123.3	2.9	2.9	0.8	0.2
Nome	17.8	368.8	51.7	0.9	0.9	0.2	0.3
North Slope	0.2	3.5	0.7	0.0	0.0	0.0	0.0
Northwest Arctic	1.8	38.1	5.7	0.1	0.1	0.0	0.0
Prince of Wales	52.1	540.9	1,516.4	69.9	67.8	15.8	0.9
Sitka	306.8	1,426.4	8,948.4	675.4	655.1	4,565.8	3.9
Skagway-Angoon	713.0	3,311.1	21,567.5	1,388.6	1,346.9	266.2	8.3
Southeast Fairbanks	1.0	9.8	15.9	0.4	0.4	0.1	0.0
Valdez/Cordova	852.0	4,262.5	24,623.5	1,597.7	1,549.8	304.5	9.9
Wade Hampton	27.8	603.5	46.6	0.6	0.5	0.1	0.5
Wrangell-Petersburg	169.8	1,399.3	5,171.3	264.4	256.4	56.5	2.7
Yakutat	8.3	162.4	70.8	1.7	1.6	0.5	0.2
Yukon-Koyukuk	2.6	54.3	17.8	0.4	0.4	0.1	0.1
TOTAL	2,556.7	17,547.5	68,837.0	4,317.3	4,187.5	5,278.4	33.6

Table 6-9
2018 Winter Commercial Marine Vessel Emission Inventories by Borough
(Excludes 9 Largest Ports)

Borough	Winter Emissions (lbs/day)						
	HC	CO	NOx	PM_{10}	$PM_{2.5}$	SOx	NH_3
Aleutians East	5.8	82.6	96.2	2.4	2.3	0.7	0.1
Aleutians West	1.1	16.0	19.0	0.5	0.5	0.1	0.0
Anchorage	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bethel	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bristol Bay	0.0	0.1	0.3	0.0	0.0	0.0	0.0
Dillingham	0.0	0.1	0.3	0.0	0.0	0.0	0.0
Fairbanks North Star	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Haines	10.5	152.7	575.4	15.1	14.6	4.9	0.3
Juneau	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenai Peninsula	3.5	61.0	253.3	6.7	6.5	2.2	0.1
Ketchikan Gateway	1.7	23.5	20.0	0.5	0.5	0.1	0.0
Kodiak Island	0.8	14.0	58.2	1.5	1.5	0.5	0.0
Lake & Peninsula	0.1	2.0	8.2	0.2	0.2	0.1	0.0
Matanuska-Susitna	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nome	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Slope	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northwest Arctic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prince of Wales	25.8	418.8	695.5	17.9	17.3	5.7	0.6
Sitka	33.7	502.1	703.5	17.9	17.3	5.5	0.7
Skagway-Angoon	28.7	480.2	1,331.1	34.9	33.8	11.4	0.9
Southeast Fairbanks	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Valdez/Cordova	3.3	56.8	236.2	6.2	6.0	2.1	0.1
Wade Hampton	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wrangell-Petersburg	57.0	864.6	1,617.7	41.7	40.4	13.2	1.3
Yakutat	7.8	154.0	35.9	0.8	0.7	0.2	0.1
Yukon-Koyukuk	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	179.9	2,828.3	5,650.5	146.3	141.8	46.7	4.4

7. CONCLUSIONS

The community recruitment and survey collection required for this analysis took more time and effort than expected. The survey approach used in this study was novel. Although originally conceived as a one-year study, it took three years to collect information from a sufficient number of communities that could be used to represent the cross-section of rural communities in the state. The study, however, produced a framework that enables collection of fuel use and activity data from rural communities, development of emission estimates from collected data, and extrapolation of emission inventories to rural Alaska. In addition, the framework can be updated in the future as new information is obtained. Areas for future development include better vehicle fleet characterization in rural Alaska, improvement in community fuel use estimates, and better insights on smokehouse wood burning and refuse burning practices.

The estimated emission inventories for the small and midsize communities in Alaska indicate a significant contribution from wood burning and fugitive dust. Even as compared to emissions from the large urban boroughs of Anchorage, Fairbanks, and Juneau, emissions from wood burning and fugitive dust in the rural communities dominate the statewide inventory. Note, however, that responses from the representative community surveys were utilized as they were received, which, in some cases, included questionably high wood use estimates. Lastly, commercial marine activity at the smaller ports and harbors in Alaska was found to contribute significantly to the total statewide commercial marine emission inventory.

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Appendix A

Inventory Preparation and Quality Assurance Plan

DRAFT

Representative Community Emissions Inventory

Prepared for:

Western Governor's Association
Western Regional Air Partnership

January 13, 2005

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Introduction

Background

The Western Regional Air Partnership (WRAP) is a collaborative effort of tribal governments, state governments, and various federal agencies to implement the recommendations of the Grand Canyon Visibility Transport Commission and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. Environmental Protection Agency's (EPA) regional haze rule. Other common western regional air quality issues raised by the WRAP membership may also be addressed. WRAP activities are conducted by a network of committees and forums composed of WRAP members and stakeholders who represent a wide range of viewpoints.

The EPA regional haze rule calls for visibility improvements in the national parks and wilderness areas in the country through the cooperation of state, tribal, and federal agencies. In order to identify the major sources of regional haze pollution, sources of visibility-related pollutants (mostly fine particulates) need to be analyzed and inventoried. The WRAP Emissions Forum is tasked with compiling emission inventory information for use in meeting regional haze rule requirements.

Alaska does not possess a coordinated statewide inventory of source-specific emission estimates. Instead, emission inventories have been developed as needed to support the development of state implementation plans (SIPs) and related maintenance plans for communities designated as nonattainment for specific criteria pollutants. Examples include Anchorage and Fairbanks for carbon monoxide (CO) and Juneau for particulate matter less than 10 microns in diameter (PM_{10}). While this approach to inventory development has worked well, it has left large portions of the state without any process for estimating criteria pollutant emissions. As a result, there is growing interest in and need for developing a statewide system for tracking pollutants.

Historically, EPA has developed statewide emission estimates for Alaska as part of the National Emission Inventory. The Alaska emissions data developed by EPA is of questionable accuracy as source-surrogates and temporal and spatial relationships developed from "lower-48" studies appear to produce large inaccuracies and inconsistencies when applied to Alaska.

Under the regional haze rule, four separate Alaskan Class I Federal areas are included that must be protected from visibility impairment. Regulations established under the regional haze rule require the development of emission inventories for these areas to support the selection of control strategies that mitigate any impairment resulting from manmade air pollution. Given the dispersed location of these areas and the need to document upwind source contributions, a significant fraction of the state will need to be inventoried for source-specific PM and related precursor emissions.

Alaska's four Class I areas that are impacted by the regional haze rule are as follows:

- Denali National Park and Preserve is located 240 miles north of Anchorage in the center of the Alaska Range. The park area totals more than 6 million acres. Denali is the only Class I site in Alaska that is easily accessible, is connected to the road system, and accommodates a wide variety of visitor uses.

- Tuxedni Wilderness Area is located in southcentral Alaska, in western lower Cook Inlet at the mouth of Tuxedni Bay. Tuxedni is composed of two islands, Chisik and Duck, totaling 6,402 acres. Tuxedni Wilderness Area is accessible only by small boats and planes, weather permitting.

- Simeonof Wilderness Area is located in the Aleutian Chain 58 miles from the mainland. It is one of 30 islands that make up the Shumagin Group on the western edge of Alaska. The island has an area of 25,141 acres. Access to Simeonof is difficult due to its remoteness and the unpredictable weather.

- Bering Sea Wilderness Area is located off the western coast of Alaska approximately 275 miles southwest of Nome. The Class I area consists of 41,113 acres and is made up of the St. Matthew Island Group (which totals approximately 81,340 acres). The Bering Sea Wilderness Area is one of the most isolated land masses in the United States, with few if any visitors.

Neither the Simeonof nor Bering Sea Class I area is likely to be impacted by emissions from the two principal population centers in the state (i.e., Anchorage and Fairbanks). Their location emphasizes the need to account for activity and emissions from rural areas and communities that are not located on the Alaska Highway System. Located between Anchorage and Fairbanks, the Denali National Park and Preserve may be impacted by emissions from both cities and emphasizes the need to account for emissions from communities located on the Alaska Highway System, as well as rural and outlying areas. Tuxedni sits on the west side of the Cook Inlet, roughly 120 miles southwest of Anchorage. It is not yet clear how much impact it receives from Anchorage or smaller communities on the Kenai Peninsula.

Approach

Sierra will follow the source-specific data collection and modeling procedures detailed in the EPA-approved Inventory Preparation Plan for Statewide Emission Inventory.[1] Several key steps, however, need to be completed prior to the collection of data. A brief review of these steps is presented below.

Community Selection – In consultation with the Project Manager, Sierra developed a framework to organize the 45 mid-size and 329 small communities into 108 common geographically distributed categories. These categories divide the state into the 27 separate counties (i.e., Boroughs), on- versus off-highway connection, and small versus midsize population levels (based on population definitions employed by the Alaska Department of Community and Economic Development). The resulting 108 categories

(27 x 2 x 2) contain numerous null sets as many regions are not connected to the highway system and no communities were distributed to those categories.

The next step in the process was to select a representative sample of communities to be surveyed. The following issues were considered in the selection of these communities:

- Geographic distribution (e.g., individual Boroughs, coastal versus interior, etc.);
- Transportation infrastructure (on versus off highway);
- Population (e.g., small, midsize, hubs, etc.);
- Proximity to Class I areas;
- Aggregate respresentativeness (overall suitability for scaling to other similar communities);
- Willingness to participate in the survey;
- Access to personnel within the community to facilitate data collection efforts; and
- Cost.

A key step in the process of selecting the communities to be surveyed was the identification of a tribal organization interested in participating in the study with personnel located in villages throughout the state. Prior to the conduct of the study, Sierra identified the Alaska Native Coalition on Employment and Training (ANCET) as an organization meeting these requirements and interested in participating. A vice president for employment and training in Kawerak, Inc., an ANCET member, worked with both Sierra and the Project Manager to select 14 separate communities to be surveyed:

- Sand Point
- Dillingham
- Arctic Village
- Northway Village
- Minto
- Huslia
- Bethel
- Barrow
- Buckland
- Stebbins
- Gambell
- Nome
- Port Graham
- Sitka

Since the selection of these communities does not guarantee their participation, it may be necessary to select replacements if local personnel are either unavailable or not interested in the study.

Seasonal Activity – Subsistence activities in Alaska vary dramatically between the summer and winter. Snow machine use during the winter is extensive and essentially nonexistent in the summer. Similarly, ATV and boat use during the summer is extensive and essentially nonexistent during the winter. The winter season is also obviously much longer than the summer season. Given these differences, a decision was made to conduct separate surveys of summer and winter activities in each of the selected communities.

Survey Design – A broad range of emission sources is located within each community (e.g., home heating, on-road and non-road vehicles and equipment, electric power generation, aircraft, commercial activity, etc.). In addition to the summer and winter variation, separate surveys will be required to collect information on fuel use and related activity metrics for each of the emission sources. The initial summer survey effort focused on residential fuel use. It was designed through consultation between Sierra, ANCET, the Project Manager, and the Alaska Tribal Coordinator for the WRAP. A separate survey will be used to obtain information on non-residential fuel use and equipment activities. Each of these surveys, residential and non-residential, will be conducted for the summer and the winter.

Conduct of the Survey – Contacts will initially be established with ANCET members to identify personnel available to conduct the survey. It is envisioned that a mixture of personnel will be involved in the study: ANCET member staff located at the regional offices (to help coordinate the identification of village personnel to collect the data) and in the villages (both to collect data and to select other local people to conduct the surveys) and local organizations (e.g., village youth groups) to supply people to conduct the surveys. To aid each organization/individual's willingness to participate, purchase orders with detailed scopes of work will be issued to pay them for their efforts. Payments will be issued upon receipt of completed survey materials to personnel conducting the surveys. They will be furnished with copies of the surveys and briefing materials, and conference calls will be held to review the goals of the study, discuss procedures to be followed, and answer any questions.

Pollutants Inventoried and Calendar Year(s) – Both annual and seasonal estimates for the following regional haze and criteria pollutants will be prepared: NOx, SOx, CO, VOC, PM_{10}, $PM_{2.5}$, NH_3, organic carbon and elemental carbon.

Organization

The remainder of this report is organized to address the methods that will be used to compute emissions from the data obtained in the surveys and the quality assurance procedures that will be employed in the development of the emission inventory estimates.

Emissions Data and Methodology

The development of an emissions inventory can be divided into four steps: (1) identifying the activity data needed to characterize source-specific operations, (2) conducting the survey, (3) selecting a methodology to translate activity measurements into emissions and (4) using those methods to combine activity measurements with appropriate emission factors to estimate emissions. Another step to be addressed in this study will be the extrapolation of emissions from the surveyed communities to represent overall emissions for the remaining communities in the state. Presented below is a review of the activity data needed to characterize each of the source categories, the methods that will be used to compute emissions for each source category, and the approach that will be used to extrapolate emissions from the surveyed communities to the rest of the state.

Collection of Activity Data

Point Sources – In developing community activity surveys, the definitions of stationary point sources (vs. those treated as lumped area sources) must be considered. This ensures emissions from sources such as power-generating facilities are neither double-counted (when combined with existing emission data complied by the Alaska Department of Environmental Conservation (ADEC)) nor omitted from consideration. Under the federal Consolidated Emissions Reporting Rule (CERR),[2] each state must submit emissions annually for all major or "Type A" point sources over 250 tons per year (tpy) of VOC, PM_{10}, $PM_{2.5}$, or NH_3 or over 2500 tpy of NOx, SOx, or CO for sources throughout the state. Alaska was required to submit its inventory of Type A point sources for calendar year 2001 by June 1, 2003. The CERR also requires states to submit emissions of "Type B" point sources over 100 tpy of VOC, NOx, SOx, PM_{10}, $PM_{2.5}$, or NH_3 or over 1,000 tpy of CO either every three years for all statewide sources or each year for one-third of the statewide sources. The first Type B inventory (for calendar year 2002 emissions) is due to EPA by June 1, 2004.

Facilities with actual emissions below these thresholds are treated as collective area sources (rather than point sources) in EPA NEI inventory submittals. EPA's most recent point source inventory for Alaska (1999 NEI) contains emission estimates from 28 unique facilities. This inventory, however, does not include all the facilities above the "Type B" cutoffs. Discussions with ADEC indicate that they are in the process of gathering emissions for all Type A and Type B point sources as mandated by the CERR. If that data is available, effort will be required to identify facilities with actual emissions less than the Type B thresholds so that they can be represented as area sources.

These requirements cover facilities on non-tribal lands. As stated in the CERR, tribes (and communities on tribal or Alaskan native lands) are encouraged but not required to develop and submit emission inventories to EPA. Thus in developing activity and emission source surveys for midsize and small Alaskan communities, several actions must be taken:

- Coordination with ADEC and review of its existing (and pending) point source inventories to ensure point source facilities and activity data collected during the surveys do not replicate data already obtained by the state or omit facilities and activity not collected by the state.

- Establish contact and work closely through statewide and regional Alaskan tribal coordinators to maximize participation in facility identification and activity surveys.

- After consultation with tribal coordinators, design community surveys in a "realistic" manner that matches the types and detail of requested activity data and source types with the anticipated level of available records and local knowledge.

The most common type of stationary point sources (or grouped area sources) we expect to find in the surveyed communities will consist of those related to fuel combustion for generation of electricity or heat and waste incineration. Thus, the overarching design of the point source survey will attempt to identify fuel consumption and type by activity type (equipment and process). Where available, data will be collected on seasonal operating patterns as well.

Area Sources – EPA guidance recommends a multi-step process for area source inventory development.[3] The first step, after defining end uses of the data, is to identify the source categories to be inventoried. The selection of sources is supposed to be based on the expected magnitude of emissions in the inventory area. In the case of Alaska, this is problematic since no inventory has previously been compiled for any area outside of Anchorage, Fairbanks, and Juneau. The following area sources are of obvious interest:

- Space heating;
- Electricity generation (the grid system in Alaska is limited and most of the state's 377 communities operate their own power plants, which in many areas are powered by Diesel engines);
- Wildfires (80% of the land mass is covered by national and state parks);
- Open burning (most communities do not have incinerators and employ some form of open burning for waste disposal [e.g., burn cages, burn boxes, etc.]); and
- Fugitive dust (this is an issue for many communities).

Many other sources appear to be of interest, but limited information is available to characterize activity levels, particularly in the smaller communities. Examples include the following:

- Aircraft refueling (there is substantial general, commercial, and military aircraft activity in Alaska; a separate discussion of aircraft is presented below);
- Petroleum vessel loading/unloading (most communities not located on the highway system receive their fuel via barge after ice is cleared from navigable waters);

- Agricultural/slash burning (there has been an effort to expand the amount of land available for agriculture; these burns are not considered "wildfires" and are not tracked by the Division of Forestry); and
- Wastewater treatment.

After accounting for the above source categories, a broad range of sources is still available for consideration. They range from asphalt paving (which may not be a significant issue in many of the smaller communities that are not located on the highway system) to commercial/consumer solvent use (which may be a significant source due to the use of gasoline by many residents as a solvent for cleaning portable equipment and small vehicles during maintenance and repair activities) to agricultural pesticides (which may be a significant issue in some communities). Given the rural nature of many of the communities, some of the unrepresentative practices (from a national perspective) may turn out to be significant contributors to local emissions. For example, many communities employ burn barrels as a method of waste disposal. EPA has developed emission estimates per kg of household waste combusted in burn barrels.[4] Effort, however, would be required to ensure that the quantity and type of wastes burned are representative of rural Alaska. Still another view is that space heating and electricity generation may be the dominant form of emissions production.

With regard to the survey, it should be designed to take advantage of information available on the storage capacity of fuel tanks located in rural communities. Two databases have been identified that track storage capacity:

- ADEC Spill Prevention and Response Division conducts surveys of storage tank capacity and organizes the data into separate searchable databases for underground and aboveground tanks (the latter database is still under development). Information on these databases can be accessed at the following website:
  http://www.state.ak.us/local/akpages/ENV.CONSERV/dspar/stp_home.htm.

- The Alaska Department of Community and Regional Affairs (DCRA) Division of Energy (now the Alaska Energy Authority) has conducted surveys of the condition of rural fuel storage facilities to determine which tanks are in need of restoration. The Division of Energy has a comprehensive rural bulk fuel program that encompasses over 150 small villages in rural Alaska that are not accessible by road. In most cases, the village fuel supply must be delivered by barge during a brief ice-free shipping season and stored throughout the year. Every village relies on aboveground tank farms for essential fuel storage, though few of these facilities presently meet minimum standards of safety or environmental protection. Insight into the condition of the tanks will be helpful in preparing estimates of breathing losses. The bulk fuel community database is not available online; however, many of the data collected in the community surveys have been incorporated into ADEC's storage tank databases.

Another source of rural energy data can be obtained from the Alaska Energy Authority's Power Cost Equalization (PCE) program. PCE is a program under which the State of Alaska pays a portion of the electric bills for consumers served by utilities participating in the program. Participation in the PCE program is limited by statute to utilities meeting certain requirements (e.g., use of Diesel-powered generators to provide more than 75 percent of the electric consumption of the utility, etc.). Data on installed generation capacity and related operating statistics can be used to estimate community-specific fuel consumption used to produce electric power on an annual basis. These data are typically published in a series of annual Alaska Electric Power Statistics reports.[5]

One approach to estimating rural energy consumption is to develop community-specific lists of storage capacity by fuel type (e.g., gasoline, Diesel, etc.) and assume that fuel is supplied only once per year to fill the tanks (informal discussions with suppliers have indicated that supply efforts often occur twice with a large spring refueling and a pre-winter topping off in late summer). Estimates of fuel used in electricity generation could be used to net out the fuel available for other forms of consumption. The surveys could be used to collect data on how fuel is used in the community (e.g., space heating, etc.) and the results could be used to distribute the estimate of fuel available for other forms of consumption. Sierra will determine the optimal method in consultation with the Project Manager based on the quality of the survey responses and collected data.

Non-road Sources – Nonroad sources include a varied assortment of mobile equipment, which can be generally categorized as follows:

- Recreational vehicles (e.g., all-terrain vehicles and off-road motorcycles);
- Logging equipment (e.g., chainsaws);
- Agricultural equipment (e.g., tractors);
- Construction equipment (e.g., graders and back hoes);
- Industrial equipment (e.g., fork lifts and sweepers);
- Residential and commercial lawn and garden equipment (e.g., leaf and snow blowers);
- Recreational and commercial marine vessels (e.g., power boats and oil tankers);[1] and
- Locomotive equipment (e.g., train engines and support equipment).[1]

The challenge of collecting survey data for nonroad sources is that there are over 80 different equipment categories and respondents in rural communities may quickly tire of responding to detailed surveys or questionnaires. While some of the equipment categories to be addressed are obvious (e.g., snowmobiles, all terrain vehicles [ATVs], outboard engines, etc.), it is unclear how many of the other categories are actually used in the rural areas (e.g., lawn mowers, string trimmers, etc.). Joint discussions between Sierra, the Project Manager, the Tribal Coordinator and the Kawerak, Inc. representative led to the selection of nonroad sources to be addressed separately in the summer and

[1] Although they will be included in the final version of the model, the current draft version of the NONROAD model is not capable of modeling emissions from oil tankers or other comparably large vessels, train engines, or aircraft.

winter surveys. The surveys are designed to collect information on household usage rates and fuel use for each of the selected sources (e.g., snow machines, boats, chain saws, snow blowers, etc).

On-road Sources – In order to calculate on-road vehicle emissions, both travel activity (e.g., vehicle miles traveled) and vehicle fleet and operating characteristics data must be collected. Our approach to obtaining each type of data is described separately below.

Vehicle Travel Activity - Under EPA NEI reporting requirements, statewide on-road mobile source emissions must be reported at the county level (i.e., borough or census area in Alaska) by roadway class. For criteria pollutants whose impacts are seasonal in nature, appropriate seasonal on-road emissions must be determined. For example, VOC and NOx ozone precursor emissions must be estimated for a typical summer workday; CO and PM emissions must be estimated for a winter workday.

The roadway class reporting categories, which are based on the roadway functional class scheme used in the Federal Highway Administration's Highway Performance Monitoring System (HPMS) database, are listed below.

- Urban – Interstate
- Urban – Other Freeways and Expressways
- Urban – Other Principal Arterial
- Urban – Minor Arterial
- Urban – Collector
- Urban – Local
- Rural – Interstate
- Rural – Other Principal Arterial
- Rural – Minor Arterial
- Rural – Major Collector
- Rural – Minor Collector
- Rural – Local

Vehicle Fleet and Operating Characteristics – A series of vehicle fleet parameters and operating conditions must be specified to produce representative vehicle emission factors using EPA's MOBILE6 emission factor model. These key emission factor model inputs are listed and how they will be collected or estimated are discussed below.

> Vehicle Registration Distributions – These consist of locally derived vehicle registration (i.e., population) distributions by age (or model year) and vehicle type. Data from the Alaska Division of Motor Vehicle (DMV) will be analyzed to determine the registration distributions by vehicle age and vehicle type. Given the small vehicle populations in some of the individual communities (and the fact that non-operated vehicles are not completely removed from the DMV database), these distributions will be compiled on a countywide basis.

Mileage Accumulation Rates – In past SIP inventory efforts in Alaska, local mileage accumulation rates were developed for Anchorage and Fairbanks from Inspection and Maintenance (I/M) program data collected from each community. I/M program data are not available for the remainder of the state. In addition, the national default mileage accumulation rates contained in MOBILE6 are likely to overstate mileage accumulation in midsize and small Alaskan communities that do not have extensive roadways systems as in large urban areas. (This is especially true for communities that are not connected to the state highway system and may have only a few tens of miles in their local roadway system.) Thus, local surveys will need to be conducted to obtain information on mileage accumulation rates for a representative sample of these communities. Both communities on and off the highway system will be included in the sample.

Fleet Mix – Having previously worked with Alaska's DMV database, Sierra has already determined that its fee-based vehicle category cannot be easily mapped to the vehicle types used by MOBILE6. For the midsize and small communities, data collected by ADOT&PF using automatic vehicle classifiers (AVCs) will be evaluated as a possible basis for development of local fleet mix inputs. The AVCs collect traffic counts by vehicle type (based on axle width and number of axles) and are used at locations throughout the state in conjunction with HPMS sampling. These data will be reviewed to determine how effectively the AVC classifications can be mapped to the vehicle type categories used in MOBILE6.

Vehicle Speeds – For travel within the midsize and small communities, speeds will be roughly estimated using posted speed limits by roadway type if travel data by roadway type can be obtained from ADOT&PF. If not, local estimates of average speed obtained from survey data will be used. For highway travel between communities, estimates based on posted speed limits will also be used. If these data are not readily available, MOBILE6 default speeds by roadway type will be assumed.

Fuel Sulfur Content – To properly estimate motor vehicle SO_2 emissions, MOBILE6 requires input on fuel sulfur content. In Alaska, gasoline sulfur content varies between 10 and 210 parts per million (ppm) and depends on the refinery supplying the fuel. In addition, the refiner's share of the market varies by community. As a result, effort will be required to obtain market share data for a representative sample of the midsize and small communities in the state. As a geographic phase-in area (GPA), Alaska is not required to meet the Tier 2 low sulfur gasoline requirements until 2007. The sulfur levels of Diesel fuel will be reduced in coming years as a result of restrictions contained in the Low Sulfur Diesel Rule.

Operating Modes – For the midsize and small communities throughout the state, national default values will be used since these data are not likely to be available or determined accurately via a survey.

Altitude – Since almost all of the vehicle travel in state occurs at altitudes below 2,500 feet, the entire state will be modeled as a low-altitude region. Thus, no survey data will be collected related to altitude.

Ambient Temperatures – Seasonal temperature data will be compiled for a set of climatically representative communities across the state from the National Climatic Data Center (NCDC).

Aircraft –Records kept by the FAA include only airports that can qualify for federal funding; that is, they meet certain minimum criteria for activity levels and accessibility. Because of this, the records do not include literally thousands of small private airstrips commonly found throughout Alaska. In addition, the aircraft model-specific data necessary to use emission models developed by the FAA are limited to the air carrier category (i.e., large commercial aircraft). Activity levels for air taxi, general aviation, and military aircraft are kept for larger airports; however, the data show operations only by aircraft categories and not by airframe model, which is necessary for modeling. For smaller airports and airstrips, records for any aircraft flying in and out of the site may not even be kept.

If Kodiak, King Salmon, Bethel or Kenai are selected to participate, data on aircraft activity are available. For the remaining communities, data on aircraft activity will need to be collected in the survey. Key items to be collected include the number of daily landing and take-off cycles (LTOs), and the aircraft type involved:

- Air carriers, which are larger turbine-powered commercial aircraft with at least 60 seats or 18,000 lbs payload capacity;
- Air taxis, which are commercial turbine or piston-powered aircraft with fewer than 60 seats or less than18,000 lbs payload capacity;
- General Aviation Aircraft, which are small piston-powered, non-commercial aircraft; and
- Military Aircraft.

Emission Calculation Methodologies

Copies of the completed surveys will be transmitted from Alaska to Sierra's offices in Sacramento by regular mail. The originals will be retained in Alaska so that questions can be addressed and so that backup copies can be produced in the event that they are lost in the mail. Sierra will review the results and discuss any issues with the local data coordinators. Sierra will also enter the results into a community/source-specific database that is tailored for use with the appropriate emission estimation methodologies. Appropriate QAP procedures will be followed in tracking and verifying the compilation of the survey results.

Once the data from the community surveys are complete and the results have been entered into the source-specific database, Sierra will calculate emission estimates. Both annual and seasonal estimates will be prepared for the following regional haze and

criteria pollutants: NOx, SOx, CO, VOC, PM_{10}, $PM_{2.5}$, NH_3, organic carbon, and elemental carbon. The approach will be to select a single community and follow the procedures outlined below to prepare emission estimates for each source category. This will be a "shakedown" effort and the results will be scrutinized in accordance with the QAP procedures specified in the next section. Notes will be prepared that document methods used to resolve unexpected issues (e.g., simplifying assumptions, etc.), key findings, etc. Once the methodologies and the resulting emission estimates for the first community have been verified, effort on the next community will begin. The same process will then be repeated before work on the next community begins. We believe that this process must be followed on a community-specific basis to ensure the integrity of the data, the calculation procedures, etc.

Presented below is a brief review of the methods that will be used to combine activity data collected in the surveys with appropriate emission factors to produce source-specific emission estimates.

Point Sources – Emissions from point sources will be computed using emission factor databases and methodologies appropriate to source configuration and operations found in Alaska. For the most part, AP-42 emission factors and methodologies will be used to develop emission factors for surveyed point sources as a function of the type of equipment and physical processes identified. Where available, emission factors and methodologies developed by Environment Canada for areas similar in climate and population density to Alaska's rural areas will be evaluated and used if demonstrably superior to US EPA approaches. Estimated actual emissions will then be calculated by combining selected emission factors with the appropriate activity data (e.g., fuel consumption).

Area Sources - EPA's guidance describes four basic approaches to emission estimation:

- Extrapolation from a sample set of sources (e.g., surveys, permit files, or other databases);
- Material balance method;
- Mathematical model; and
- Emission factors applied to activity levels.

The preferred EIIP approach is to extrapolate from a sample set of data for the industry/activity to the entire population. This approach, however, is based largely on the premise that permit data are used as the basis for extrapolation. As noted in the point source discussion, applicable thresholds eliminate most, if not all, area sources from consideration.

Material balance techniques are focused on the estimation of evaporative emissions and have limited applicability, but could be used as an alternate to conducting source testing for candidate sources. A variety of mathematical models are available to prepare emission estimates. Most are focused on specific categories of activity (e.g., WIND is used to estimate emissions from wind erosion, WATER8 is available to estimate emissions from wastewater treatment, etc.). Recently, EPA developed the Area Source

Emissions Model (ASEM).[6] It has the flexibility to provide emission estimates for a broad category of sources and activities using either a top-down or bottom-up approach. It provides state and county coverage and can estimate emissions on either an annual or monthly basis. A review of the available documentation,[7] however, indicates that the model provides estimates for only PM_{10}, $PM_{2.5}$, and NH_3. Additional algorithms are planned for calculating VOC, NOx, and SO_2 as funding becomes available.

The final method of estimating emissions is through the combination of emission factors (typically defined in units of grams per unit of activity) and activity estimates (measured in units compatible with the emission factors). This is the approach that ADEC has employed in preparing area source emission estimates for the SIP, toxic, and criteria pollutant emission inventories. It relies largely on the use of AP-42 emission factors and related methodologies to estimate emissions. This is the approach that we plan to employ in this study.

Non-road Sources – EPA's NONROAD model calculates tons of emissions for a given geographical area using the following factors:

- An equipment population;
- An equipment-specific emission factor (in grams per horsepower-hour);
- An average horsepower rating of the equipment;
- The estimated annual equipment activity (hours per year); and
- The average load factor.

In addition, seasonal (month or season) and day of week (i.e., weekend or weekday) adjustments are applied depending on whether the end-user requests an inventory estimate based on an annual, seasonal, or daily basis. The NONROAD model employs a "top-down" approach to calculate non-road source emissions. The NONROAD default equipment populations are based on national averages, then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities. EPA recognizes the limitations inherent in this "top-down" approach, and realizes that locally generated inputs to the model will increase the accuracy of the resulting output. Therefore, the data collected in the survey will be used to more accurately reflect the equipment population and activity levels in the various Alaskan communities addressed in the survey. Locomotive emissions will be calculated separately using EPA guidance emission factors (which are fuel based).

On-road Sources - Emissions for on-road mobile sources will be calculated by combining travel activity data (i.e., vehicle miles traveled) obtained from data sources or local surveys as described earlier with emission factors obtained from EPA's MOBILE6 vehicle emission factor model. Using data for each sampled community, local fleet inputs (e.g., registration fractions by vehicle type and model year) and operating characteristics will be compiled for input into MOBILE6.

A series of MOBILE6 runs will then be generated for each representative community fleet and operating characteristics. A simple spreadsheet or database will be used to calculate and report on-road vehicle emissions for each community. Where supported by

the disaggregated travel activity data (e.g., for on-highway communities), the emissions will be separated by vehicle type and roadway type (interstate, arterial, etc.) as contained in the Source Classification Code (SCC) structure for on-road sources. Where disaggregated travel activity data are not available, emissions will be assigned to a roadway type (or types) based on best judgment and noted as such.

Aircraft – The current FAA required method for estimating non-cruising (i.e., below the mixing height) aircraft emission inventories at airports employs the use of the EDMS model. The model combines specified aircraft and activity levels with default emissions factors in order to estimate annual aircraft inventories of CO, HC, NOx, SOx, PM_{10}, and $PM_{2.5}$ for a specific airport. Aircraft activity levels in EDMS are expressed in terms of LTOs, which consist of four non-cruising aircraft operating modes: taxi and idle, take-off, climb-out, and landing. Default values for the amount of time a specific aircraft spends in each mode, or the TIMs, are coded into EDMS, but may be updated with airport-specific numbers where available. In addition, the model includes updateable default settings for the mixing height and aircraft engine assignments. In order to use EDMS, a separate setup and model run for each airport or airbase is required, and each combination of aircraft model, engine type, and activity level to be considered in the modeling scenario must be explicitly entered. Currently, the model lacks the capability to accept multiple input files for multiple airports. As a result, set up for a study involving a large number of airports will be laborious and time-consuming.[8]

In addition to EDMS, fleet-average emission factors are available for CO, HC, NOx, and SOx from the EPA's "Procedures for Emission Inventory Preparation" (1992) for general aviation and air taxi aircraft.[9] Similar to the EDMS model, the fleet-average emission factors in the EPA procedures assume a default mixing height of 3,000 feet.[2] In addition, the EPA report includes factors for converting HC to VOC, with separate factors available for piston and turbine aircraft. These emission factors are helpful when total activity by aircraft category is given but aircraft model-specific data are unavailable.

EDMS will be used to compute emissions for the larger international and military airports and for the regional hubs. It is expected that more generalized fleet average emission factors will be used to characterize emissions at the hub destination airports (i.e., those with scheduled air taxi service from the regional hubs) and the smaller seasonal airfields.

Expansion of Individual Community Estimates to Borough Estimates

As discussed in the Introduction, communities will be allocated to a total of 108 separate categories (27 counties x 2 community sizes x 2 highway categories). Many of these categories, however, will not be populated with communities since many areas of the state are not connected to the highway system.

The method used to extrapolate emission estimates from the 14 surveyed communities to the remaining 360 communities will be to first extrapolate based on population to other

[2] Model users can set the mixing height to levels consistent with meteorological data for each airport. The levels used to compute emissions in this study should be consistent with those employed in the ongoing WRAP Alaska Aviation Emissions Inventory project.

communities within the same county/community size/highway category. Care should be taken to ensure that selected communities are in mutually exclusive categories (i.e., no two are located within one of the same 108 available categories). The next step will be to extrapolate from the 14 surveyed communities to the remaining communities that are co-located geographically (e.g., emissions from a surveyed Aleutians East Borough small off-highway community would be extrapolated to a small off-highway Aleutians West Census Area, etc.).

Extrapolated emissions, by source category for each community within each county, would then be totaled to compute county-level emission estimates in NIF v3.0 format. QAP procedures specified in the next section would be applied to confirm and document the validity of the results.

Quality Assurance Plan

This section presents a review of the QA procedures to be employed during the development of the representative community emission inventory. It includes all of the critical elements recommended in the U.S. EPA document *Guidance for the Preparation of Quality Assurance Plans for Ozone/Carbon Monoxide State Implementation Plan Emission Inventories*,[10] as well as guidance provided through the Emission Inventory Improvement Program (EIIP).[11] It also provides written instructions for the technical and quality aspects associated with development of the new emission inventories. It is designed so that QA/QC procedures are implemented throughout the entire inventory development process. This will ensure that the inventory is as complete, accurate, comparable, and representative as possible.

Inventory tasks and QC procedures will include data checking by the inventory development team (IDT) throughout the development of the inventory and final emission report. These procedures include, but are not limited to, the following:

- The development and implementation of written procedures for data collection, data assessment, data handling, calculation of emissions, and reporting;
- Adequate management and supervision of the work;
- Review of all calculations for technical soundness and accuracy, including verification that the appropriate emission factors were used and the impacts of controls were correctly addressed;
- Correct assignment of Source Category Codes;
- Assignment of DARS scores;
- Use of technically sound approaches when developing results based on engineering judgment;
- Documentation of the data in a manner that will allow reconstruction of all inventory development activities; and
- Maintenance of an orderly master file of all the data gathered and a copy-ready version of the final inventory submitted to the WRAP Emission Forum.

The emission inventories developed in accordance with this plan are for SIP development and are considered Level II, based on guidance provided by the 1996 EIIP. The estimates contained in the inventories will be used to make decisions about the need for and types of control strategies required to ensure reasonable progress in meeting visibility goals for Alaska's Class I areas. As a result, they must satisfy applicable quality assurance (QA) requirements.

The first step in this process is establishing the data quality objectives (DQO) for the new inventories. Table 1 presents a summary of the procedures to be employed in meeting the DQOs. It shows that considerable effort will be focused on meeting accuracy, completeness, representativeness, and comparability objectives. Table 2 shows the data quality indicators (DQIs) that will be used to measure progress towards the DQOs. The Data Attribute Rating System (DARS)[12] will be used to verify the desired inventory accuracy.

Table 1
Data Quality Objectives

DQO	Procedure for Achieving Objective
Accuracy	For point and onroad mobile sources, the data generator will check 100% of the calculations, and another equally qualified inventory development team member will check 20% of the calculations. For area and nonroad mobile sources, the data generator will check 100% of the calculations, and another equally qualified IDT member will check 10% of the calculations. In all cases, the data validator will develop a written summary of his or her activities, and will conduct follow-up activities to ensure that data are corrected as needed. If more than 5% of the calculations checked by the data validator need to be revised, then 100% of the calculations will be checked.
Completeness	Extensive planning will be conducted prior to data collection to identify all applicable emission sources. After identifying these sources, the goal will be to determine 100% of the emissions from the largest emitting sources from each source category and as many of the minor sources as possible within the time frame allotted for the work. Those sources identified but not included in the inventory will be identified in the data file and final report.
Representativeness	Technical personnel will review all of the primary source data AND compare them to previous emission results and similar results from comparable regions to determine the reasonableness of the emissions estimates and representativeness of the data.
Comparability	To ensure that the data are comparable, standard procedures will be followed and results will be presented in the same units that were used in previous criteria and toxic pollutant inventories.

Table 2
Data Quality Indicators

DQO	Inventory DQI Target Values
Accuracy	Achieve DARS score >= 0.7 for all area sources contributing >10% of total emissions of CO Achieve DARS score >=0.8 for all point sources >=100 tons per year (TPY). Achieve DARS score >=0.7 for onroad mobile source inventory. Achieve DARS score <=0.5 for nonroad mobile source inventory.
Completeness	100% of all point sources >=100 tpy. 90% of all other point sources
Representativeness	Community stratifications presented in the Introduction.
Comparability	Results to be compared to recent criteria and toxic pollutant inventories.

Managerial Responsibilities

Sierra will lead the preparation of the community emission inventories. Key assignments shall include those outlined below.

Source Inventory Development Managers – responsible for planning and leading source-specific inventory development activities.

QA/QC Coordinator – the person responsible for ensuring that adequate QA/QC procedures are incorporated into the inventory development process. The QA Coordinator's responsibilities and activities are as follows:

- Help develop the QAP;
- Provide QA training to inventory development and QA personnel;
- Attend inventory status meetings;
- Follow up on recommendation for corrective actions;
- Keep the Inventory Development Manager informed of actions;
- Work with the WRAP Project Manager to resolve any quality concerns that cannot be resolved at the inventory management level; and
- Maintain a file of findings and corresponding corrective actions.

The QA Coordinator reports directly to Sierra's Project Manager overseeing the development of the inventory. These reporting lines help provide an objective approach to the implementation of the QA program and reporting of quality issues.

Schedule

Data collection activities are to be completed by the end of January. Emission inventory estimates will be completed by the end of February and the draft report is to be completed by the end of March.

General QA/QC Procedures

QA/QC procedures described in this QAP were developed to help ensure data accuracy, completeness, representativeness, and comparability. These procedures have been incorporated in the technical procedures, where applicable, and will be implemented by the IDT throughout the planning, data collection, emission estimation, and reporting phases of the inventory development program.

QC procedures will be implemented by the IDT during inventory development to meet the technical objectives and DQOs. These activities will be conducted at the following steps in the inventory development process:

- Data collection;
- Data documentation;

- Calculation of emissions;
- Data checking and DARS scoring;
- Reporting; and
- Maintenance of the master file.

Data collection will be conducted according to U.S. EPA-approved procedures. The approach and supporting documents or references will be thoroughly documented and included in the emissions report.

All activities conducted by the IDT will be documented. The traditional approach is to use bound notebooks with indices to facilitate the retrieval of recorded information. An alternate approach is to record activities electronically and make this information available to team members located in different parts of the state. To enhance communication and productivity, team members will be allowed to employ either approach but will be encouraged to track information relative to the development of the inventory electronically. This daily log of activities will help another IDT member reproduce the emission results and allow an evaluation of data accuracy and completeness.

The following procedures are to be followed when documenting data in the notebooks:

- Data will recorded legibly and in black ink;

- Entries will be corrected by drawing a single line through the data and writing the correct data above or below the correction (with initials, date, and explanation of corrections to allow reconstruction of the work);

- Complete descriptions of all data sources will be included (references to be included in final inventory report);

- Units of measurements will provided for emission sources that are omitted from the final inventory (justification required in report);

- The procedures used to calculate emissions will be described and example calculations will be provided;

- The approach used to determine completeness for each source type will be described;

- Documents from which emission factors are taken will be identified and referenced; and

- The source, agency, group, or company providing information by telephone will be identified (include telephone number and date information was provided).

Worksheets and contact reports may also be used to maintain records of data sources or calculations; however, the same guidelines must be followed when recording information on them. A file will be developed specifically for these forms to ensure that they are retained and are easily located when the data are needed to calculate emissions. A contact report should include the date of contact; originator name, title, organization, and address of person contacted; and a summary. All worksheets, electronic spreadsheets, and notebooks will be reviewed periodically by the inventory development task leaders to determine whether the procedures described above are being followed. This review should be evidenced by a dated signature on the notebook pages or worksheets reviewed (i.e., reviewed by _____ on _____).

Data used in calculation emissions should be checked for data accuracy, reasonableness, and completeness. The results from data checking will be documented to further qualify the emission estimates. In addition to the DARS scores assigned, the number of data points checked assists reviewers in evaluating the accuracy of the completed emissions report. Documentation of DARS scoring and data checking should include descriptions of the rationale for scoring, the data checked, and the dated signature of the reviewer.

Data Reporting

Reporting will be accomplished by submitting written documentation and emissions summaries to the WRAP Emission Forum. All supporting documentation, project notebooks, data sheets, and calculations shall be submitted for review.

The report will include summary tables, raw listings of equipment, activity levels and emissions from individual sources, and a QA documentation section. A detailed inventory report allows comparison of baseline inventories between one area and another and the evaluation of the impact of control strategies, and also facilitates updates to the inventory and development of projection inventories.

In addition to EIIP guidance, the U.S. EPA report *Example Documentation Report for 1990 Base Year Ozone and Carbon Monoxide State Implementation Plan Emission Inventories*[13] will be followed. These documents provide guidance for presenting and documenting SIP emissions inventories, and contain examples of how to present and verify inventory development efforts. The QA documentation section of the emissions inventory will provide enough detail so that the inventory development described in the report can be compared to the information provided in this QAP. Any discrepancies will be identified and explained.

At a minimum, documentation should describe in general terms how the inventory data were collected and where they came from. The report will include the components listed below.

- A description of the geographic area included in the inventory, including documentation for any adjustments made to the original designated area. Documentation shall reference all sources of current or projected data, and include maps of borough boundaries for excluded areas.

- The base year of the emissions inventory.

- The population of the area, and the source of the population data.

- Efforts taken as part of QA program.

- Procedures used to temporally allocate each source category (e.g., selection of the months comprising the seasons, seasonal variations in activity levels at sources, daily variation in activity levels, etc.).

- Procedures used to spatially allocate the emissions inventory. If a dispersion model will be used for control strategy demonstrations, a map of the geographic area with the modeling domain and grid squares overlaid shall be included. The grid square sizes need to be indicated on the map.

The QA documentation section of the inventory report will describe each deviation from approved procedures or findings that could compromise the successful outcome of the inventory. Documentation of each finding will include a description of the action or data reviewed that led to the quality concern, along with a recommendation for corrective action. The QA documentation section of the inventory report will then discuss how the recommended corrective actions were implemented.

References

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12. Beck, L.L., R.L Peer, L.A. Bravo, and Y. Yan, "A Data Attribute Rating System," presented at the Air & Waste Management Association Specialty Conference on Emission Inventory Issues, Raleigh, North Carolina, November 1994.
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Appendix B

Sample Residential and Non-Residential Surveys

Rural Alaska Fuel Use Survey

We use fuel everyday in our village. While fuel heats our homes, moves our vehicles, and cooks our food, it also creates air pollution. Too much air pollution causes health problems and dirties our skies. This survey will help determine how much air pollution is produced in villages.

We value clean air and the health of our village. At times, you may have noticed a brown layer of air near the horizon limiting your view. This is called haze and it has become a concern to people across the country. We need to learn how much air pollution in Alaska comes from factories, other countries, large Alaskan cities like Anchorage and Fairbanks, airplanes, or from rural villages.

Air pollution comes from many sources: power production, home heaters, wood stoves, trash burning, cars, trucks, boats, and 4-wheelers. There is little information on village fuel use and air pollution. This is why we need your help in filling out the survey. With your support we can use this information to figure out how much pollution is released into the surrounding air. Since different sources are used depending on the season, separate surveys will be conducted in the summer and the winter.

This survey is being funded by both tribal and state governments, through the Western Regional Air Partnership. They are interested in collecting data on a broad spectrum of villages across Alaska. The results will be provided to participating tribal councils in early 2005 and can be used to help keep our air clean and improve village health. Another benefit of this survey is a better understanding of fuel use and ideas for controlling costs.

Thank you for your help and willingness to work with us.

Summer Residential Fuel Use Survey

FUEL USED FOR HEATING PURPOSES

Fuel Use at Home

What types of fuel do you use for heat in the summer at home? (please mark a v next to each type that you use)

Wood _____
Fuel Oil _____
Propane _____
Other (please specify) _____

How much fuel do you use during a week or month in the summer at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Wood (cords)*	_____	_____	_____
Fuel Oil (gallons)	_____	_____	_____
Propane (gallons)	_____	_____	_____
Other (please specify)	_____	_____	_____

*1 cord = 4 ft x 4ft x 8ft stack

What heaters do you use for heat at home? (please mark a v next to each type that you use)

Wood Stove _____
Heating with water (hydronic) _____
Central oil furnace _____
Toyo, Monitor heater _____
Other (please specify) _____

Fuel Use at Camp (If applicable)

What types of fuel do you use for heat in the summer at camp? (please mark a v next to each type that you use)

Wood _____
Fuel Oil _____
Propane _____
Other (please specify) _____

How much fuel do you use during a week or month in the summer at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Wood (cords)*	_____	_____	_____
Fuel Oil (gallons)	_____	_____	_____
Propane (gallons)	_____	_____	_____
Other (pelase specify)	_____	_____	_____

*1 cord = 4 ft x 4ft x 8ft stack

What heaters do you use for heat at camp? (please mark a v next to each type that you use)

Wood stove _____
Toyo, Monitor heater _____
Other (please specify) _____

FUEL USED FOR MOTORIZED EQUIPMENT

Fuel Use at Home

Do you operate any motorized equipment at home? (if yes, please mark the number of hours that you operate each type during the summer)

	Week	Month	Don't Know
Chain saw	_____	_____	_____
Brush/weed trimmer	_____	_____	_____
Generator	_____	_____	_____
Water Pump	_____	_____	_____
Other (please specify)	_____	_____	_____

How much fuel do you use in all of your motorized equipment during a week/month in the summer at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

Fuel Use at Camp (If applicable)

Do you operate any motorized equipment at camp? (if yes, please mark the number of hours that you operate each type during the summer)

	Week	Month	Don't Know
Chain saw	_____	_____	_____
Brush/weed trimmer	_____	_____	_____
Generator	_____	_____	_____
Water Pump	_____	_____	_____
Other (please specify)	_____	_____	_____

How much fuel do you use in all of your motorized equipment during a week/month in the summer at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

OUTDOOR BURNING

Do you burn anything outdoors? (please specify with a v next to each type)

	Home	Camp
Open burn (trash burn)	_____	_____
Burn barrel	_____	_____
Camp/cook fires	_____	_____
Smokehouse	_____	_____

How many hours do you burn outdoors during a week/month in the summer at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Outdoor burn	_____	_____	_____
Burn barrel	_____	_____	_____
Camp/cook fires	_____	_____	_____
Smokehouse	_____	_____	_____

How many hours do you burn outdoors during a week/month in the summer at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Outdoor burn	_____	_____	_____
Burn barrel	_____	_____	_____
Camp/cook fires	_____	_____	_____
Smokehouse	_____	_____	_____

FUEL USED FOR TRANSPORTATION

Do you own a vehicle? (if yes, please mark the number of gallons that you typically use during a week or month in the summer)

	Gasoline	Diesel	Week/Month/Don't Know
Car	_____	_____	_____
Pickup Truck/SUV	_____	_____	_____
Motorcycle	_____		_____

How many miles do you drive in a week during the summer?

Car	_____
Pickup Truck/SUV	_____
Motorcycle	_____

Do you own a boat? (if yes, please mark the number of hours that you operate each engine during a typical week or month in the summer)

	Boat #1	Boat #2	Boat #3	Week/Month/Don't Know
2-stroke outboard	_____	_____	_____	_____
4-stroke outboard	_____	_____	_____	_____
Inboard gasoline	_____	_____	_____	_____
Inboard Diesel	_____	_____	_____	_____

How much fuel do you use in your boat(s) during a week/month in the summer? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

Do you own a 4-wheeler?
(if yes, please mark how many by type)

2-stroke _____
4-stroke _____

How much fuel do you use in your 4-wheeler(s) during a week/month in the summer? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____

How many hours do you operate your 4-wheeler(s) during a week/month in the summer? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
2-stroke (hours)	_____	_____	_____
4-stroke (hours)	_____	_____	_____

Winter Residential Fuel Use Survey

FUEL USED FOR HEATING PURPOSES

Fuel Use at Home

What types of fuel do you use for heat in the winter at home? (please mark a v next to each type that you use)

Wood	_____
Fuel Oil	_____
Propane	_____
Other (please specify)	_____

How much fuel do you use during a week or month in the winter at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Wood (cords)*	_____	_____	_____
Fuel Oil (gallons)	_____	_____	_____
Propane (gallons)	_____	_____	_____
Other (please specify)	_____	_____	_____

*1 cord = 4 ft x 4ft x 8ft stack

What heaters do you use for heat at home? (please mark a v next to each type that you use)

Wood Stove	_____
Heating with water (hydronic)	_____
Central oil furnace	_____
Toyo, Monitor heater	_____
Other (please specify)	_____

Fuel Use at Camp (If applicable)

What types of fuel do you use for heat in the winter at camp? (please mark a v next to each type that you use)

Wood	_____
Fuel Oil	_____
Propane	_____
Other (please specify)	_____

How much fuel do you use during a week or month in the winter at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Wood (cords)*	_____	_____	_____
Fuel Oil (gallons)	_____	_____	_____
Propane (gallons)	_____	_____	_____
Other (please specify)	_____	_____	_____

*1 cord = 4 ft x 4ft x 8ft stack

What heaters do you use for heat at camp? (please mark a v next to each type that you use)

Wood stove	_____
Toyo, Monitor heater	_____
Other (please specify)	_____

FUEL USED FOR MOTORIZED EQUIPMENT

Fuel Use at Home

Do you operate any motorized equipment at home? (if yes, please mark the number of hours that you operate each type during the winter)

	Week	Month	Don't Know
Chain saw	_____	_____	_____
Snow blower	_____	_____	_____
Generator	_____	_____	_____
Other (please specify)	_____	_____	_____

How much fuel do you use in all of your motorized equipment during a week/month in the winter at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

Fuel Use at Camp (If applicable)

Do you operate any motorized equipment at camp? (if yes, please mark the number of hours that you operate each type during the winter)

	Week	Month	Don't Know
Chain saw	_____	_____	_____
Snow blower	_____	_____	_____
Generator	_____	_____	_____
Other (please specify)	_____	_____	_____

How much fuel do you use in all of your motorized equipment during a week/month in the winter at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

OUTDOOR BURNING

Do you burn anything outdoors? (please specify with a v next to each type)

	Home	Camp
Open burn (trash burn)	_____	_____
Burn barrel	_____	_____
Other	_____	_____

How many hours do you burn outdoors during a week/month in the winter at home? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Open burn	_____	_____	_____
Burn barrel	_____	_____	_____
Other	_____	_____	_____

How many hours do you burn outdoors during a week/month in the winter at camp? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Open burn	_____	_____	_____
Burn barrel	_____	_____	_____
Other	_____	_____	_____

FUEL USED FOR TRANSPORTATION

Do you own a vehicle? (if yes, please mark the number of gallons that you typically use during a week or month in the winter)

	Gasoline	Diesel	Week/Month/Don't Know
Car	_____	_____	_____
Pickup Truck/SUV	_____	_____	_____
Motorcycle	_____		_____

How many miles do you drive in a week during the winter?

Car	_____
Pickup Truck/SUV	_____
Snow Machine	_____

Do you own a snow machine? (if yes, please mark the number of hours that you operate each engine during a typical week or month in the winter)

	Snow Machine #1	Snow Machine #2	Snow Machine #3	Week/Month/Don't Know
2-stroke snow machine	_____	_____	_____	_____
4-stroke snow machine	_____	_____	_____	_____

How much fuel do you use in your snow machine(s) during a week/month in the winter? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____
Diesel (gallons)	_____	_____	_____

Do you own a 4-wheeler?
(if yes, please mark how many by type)

2-stroke	_____
4-stroke	_____

How much fuel do you use in your 4-wheeler(s) during a week/month in the winter? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
Gasoline (gallons)	_____	_____	_____

How many hours do you operate your 4-wheeler(s) during a week/month in the winter? (please mark the time period that is easiest to remember)

	Week	Month	Don't Know
2-stroke (hours)	_____	_____	_____
4-stroke (hours)	_____	_____	_____

SUMMER AND WINTER SURVEY
City Operations

FUEL USE

- Please indicate the amount of fuel typically purchased for city operations during each season.
  SUMMER (April to September)

  Diesel/Heating Oil _____ gallons, purchased _____times per (circle one) week / month

  Gasoline _____ gallons, purchased _____times per (circle one) week / month

  WINTER (October to March)

  Diesel/Heating Oil _____ gallons, purchased _____times per (circle one) week / month

  Gasoline _____ gallons, purchased _____times per (circle one) week / month

- Please estimate the percentage of each fuel used for the following (total 100% per fuel) during the **SUMMER**.

	% Diesel Fuel	% Gasoline
Heating	_____	__n/a__
Off-Road Equipment/Generators/Pumps	_____	_____
On-Road Vehicles/Trucks/Buses	_____	_____
Marine Vessels	_____	_____
Other, please specify _____	_____	_____
TOTAL	100%	100%

- Please estimate the percentage of each fuel used for the following (total 100% per fuel) during the **WINTER**.

	% Diesel Fuel	% Gasoline
Heating	_____	__n/a__
Off-Road Equipment/Generators/Pumps	_____	_____
On-Road Vehicles/Trucks/Buses	_____	_____
Marine Vessels	_____	_____
Other, please specify _____	_____	_____
TOTAL	100%	100%

FACILITY HEATING/CLIMATE CONTROL

- Please circle the type/s of heater used in the different city facilities (circle all that apply).

  Wood stove

  Water Heating (hydronic)/Boiler

  Central oil furnace

  Toyo, Monitor heater

  Propane

  Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

OTHER MOTORIZED EQUIPMENT

- Please identify the type of motorized equipment, if any, that are owned and operated by the city by indicating the fuel, size/capacity, and how often the typical equipment is used during each season.

	No. of Equipment	Characteristics
Generators	_____	fuel: (circle one) Diesel / Gasoline
		____ Hp rating, ____ kW capacity
		SUMMER USE (each piece): ___ hours per (circle one) day / week / month
		WINTER USE (each piece): ___ hours per (circle one) day / week / month
Water Pumps	_____	fuel: (circle one) Diesel / Gasoline
		____ Hp rating
		SUMMER USE (each piece): ___ hours per (circle one) day / week / month
		WINTER USE (each piece): ___ hours per (circle one) day / week / month

CITY VEHICLES AND ACTIVITY

- Please identify the types and number of city-owned vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/Vans/SUVs	_____	_____
4-Wheelers	_____	_____
Buses	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
4-Wheelers	_____	_____	miles per (circle one) day / week / month
Buses	_____	_____	miles per (circle one) day / week / month

SUMMER AND WINTER SURVEY
School

FUEL STORAGE TANKS

- Please indicate the fuel tank sizes located in the schools and their refill frequencies for each season.

SUMMER (April to September)

Diesel/Heating Oil Tank _____ gallons filled _____times per (circle one) week / month

Gasoline Tank _____ gallons filled _____times per (circle one) week / month

WINTER (October to March)

Diesel/Heating Oil Tank _____ gallons filled _____times per (circle one) week / month

Gasoline Tank _____ gallons filled _____times per (circle one) week / month

FACILITY HEATING/CLIMATE CONTROL

- Please circle the type/s of heater used in the schools (circle all that apply).

Wood stove

Water Heating (hydronic)/Boiler

Central oil furnace

Toyo, Monitor heater

Propane

Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

OTHER MOTORIZED EQUIPMENT

- Please identify the type of motorized equipment, if any, that are used in the premises by indicating the fuel, size/capacity, and how often they are used during each season.

Generator (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG

____ Hp rating, ____ kW capacity

SUMMER USE: ____ hours per (circle one) day / week / month

WINTER USE: ____ hours per (circle one) day / week / month

Water Pump (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG

____ Hp rating, ____ kW capacity

SUMMER USE: ____ hours per (circle one) day / week / month

WINTER USE: ____ hours per (circle one) day / week / month

SCHOOL VEHICLES AND ACTIVITY

- Please identify the types and number of school-owned vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/SUVs	_____	_____
4-Wheelers	_____	_____
School Buses	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
4-Wheelers	_____	_____	miles per (circle one) day / week / month
School Buses	_____	_____	miles per (circle one) day / week / month

SUMMER AND WINTER SURVEY
Wastewater Treatment Facility

MOTORIZED (NON-ELECTRIC) EQUIPMENT

- Please identify the type of motorized equipment, if any, that are used in the premises by indicating the fuel, size/capacity, and how often they are used during each season.

Generator	(circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG ____ Hp rating, ____ kW capacity SUMMER USE: ____ hours per (circle one) day / week / month WINTER USE: ____ hours per (circle one) day / week / month
Water Pump	(circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG ____ Hp rating SUMMER USE: ____ hours per (circle one) day / week / month WINTER USE: ____ hours per (circle one) day / week / month
Air Compressor	(circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG ____ Hp rating SUMMER USE: ____ hours per (circle one) day / week / month WINTER USE: ____ hours per (circle one) day / week / month
Gas Compressor	(circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG ____ Hp rating SUMMER USE: ____ hours per (circle one) day / week / month WINTER USE: ____ hours per (circle one) day / week / month

OFFICE HEATING/CLIMATE CONTROL

- Please circle the type(s) of heater(s) used in the facility (circle all that apply).

Wood stove

Water Heating (hydronic)/Boiler

Central oil furnace

Toyo, Monitor heater

Propane

Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

FACILITY VEHICLES AND ACTIVITY

- Please identify the types and number of facility-owned and operated vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/SUVs	_____	_____
4-Wheelers	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
4-Wheelers	_____	_____	miles per (circle one) day / week / month

SUMMER AND WINTER SURVEY
Landfill

WASTE PROCESSESING

- Please fill in the total amount of refuse processed at the landfill

  Total Waste Processed _____ in tons per (circle one) day / month / year

- Please indicate the processing method used in the facility (circle method).

  Incinerator

  Open Burning

  Burning Cage

  Enclosed Burn Box

- Is refuse processed year-round or seasonally (e.g. more in the summer, winter, summer only, etc.)? Please explain.

  _____

  _____

LANDFILL EQUIPMENT

- Please identify the types and number of facility-owned and operated equipment.

	# of Gasoline-Powered	# of Diesel-Powered
Compactor	_____	_____
Front-End Loaders	_____	_____
Scrapers	_____	_____

- Approximately how long is each type of equipment operated during each season?

	SUMMER	WINTER	UNITS
Compactor	_____	_____	hours per (circle one) day / week / month
Front-End Loader	_____	_____	hours per (circle one) day / week / month
Scraper	_____	_____	hours per (circle one) day / week / month

FACILITY VEHICLES (Unless Included In City Operations)

- Please identify the types and number of facility-owned and operated vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/SUVs	_____	_____
Refuse Haulers	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
Refuse Haulers	_____	_____	miles per (circle one) day / week / month

OTHER MOTORIZED (NON-ELECTRIC) EQUIPMENT (Unless Included In City Operations)

- Please identify the type of motorized equipment, if any, that are used in the premises by indicating the fuel, size/capacity, and how often they are used during each season.

Generator (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG

____ Hp rating, ____ kW capacity

SUMMER USE: ____ hours per (circle one) day / week / month

WINTER USE: ____ hours per (circle one) day / week / month

Water Pump (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG

____ Hp rating, ____ kW capacity

SUMMER USE: ____ hours per (circle one) day / week / month

WINTER USE: ____ hours per (circle one) day / week / month

OFFICE HEATING/CLIMATE CONTROL

- Please circle the type/s of heater used in the facility (circle all that apply).

Wood stove

Water Heating (hydronic)/Boiler

Central oil furnace

Toyo, Monitor heater

Propane

Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

SUMMER AND WINTER SURVEY
Fuel Supplier

FUEL SOLD

- Please indicate the amount of each fuel sold for each season.

SUMMER (April-September)

Diesel/Heating Oil	_____ gallons per month
Gasoline	_____ gallons per month
AvGas	_____ gallons per month
Propane	_____ gallons per month

WINTER (October-March)

Diesel/Heating Oil	_____ gallons per month
Gasoline	_____ gallons per month
AvGas	_____ gallons per month
Propane	_____ gallons per month

FUEL USE

- If known, please estimate the percentage of each fuel sold for the following purposes for each season (total 100% per fuel).

SUMMER (April-September)

	% Diesel Fuel	% Gasoline	% Propane
Residential Use (Heating/Cooking/etc.)	_____	_____	_____
Off-Road Equipment/Generators/Pumps	_____	_____	_____
On-Road Vehicles/Trucks/Buses	_____	_____	_____
Marine Industry	_____	_____	_____
Other, please specify _____	_____	_____	_____
TOTAL	100%	100%	100%

WINTER (October-March)

	% Diesel Fuel	% Gasoline	% Propane
Residential Use (Heating/Cooking/etc.)	_____	_____	_____
Off-Road Equipment/Generators/Pumps	_____	_____	_____
On-Road Vehicles/Trucks/Buses	_____	_____	_____
Marine Industry	_____	_____	_____
Other, please specify _____	_____	_____	_____
TOTAL	100%	100%	100%

SUMMER AND WINTER SURVEY
Klawock Airport (AKW)

AIRCRAFT ACTIVITY

- The following data was obtained from the Federal Aviation Administration. Please comment if these statistics seem reasonable for Klawock Airport.

	COMMENTS
Aircraft operations: Average of 38 per week	_____
82.5% commercial/air taxi	_____
17.5% general aviation	_____

GROUND SUPPORT EQUIPMENT

- Is all of the Ground Support Equipment used in the facility powered by Diesel? (circle answer) YES / NO

  If NO, please list equipment that are not Diesel-fueled and the alternate fuel:

  _____

  _____

  _____

  _____

GROUND ACCESS VEHICLES

- Please identify the types and number of airport/airstrip-owned and operated vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/SUVs	_____	_____
4-Wheelers	_____	_____
Buses	_____	_____

- Approximately how many miles is each type of vehicle typically driven in the airport/airstrip during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
4-Wheelers	_____	_____	miles per (circle one) day / week / month
Buses	_____	_____	miles per (circle one) day / week / month

OFFICE HEATING/CLIMATE CONTROL

- Please circle the type/s of heater/s used in the facility (circle all that apply), if any.

  Wood stove

  Water Heating (hydronic)/Boiler

  Central oil furnace

  Toyo, Monitor heater

  Propane

  Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

FUEL STORAGE TANKS

- Please indicate the fuel tank sizes located in the premises, if any, and their refill frequencies for each season.

SUMMER (April to September)

AvGas Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
AvGas Tank 2	_____ gallons, filled	_____ times per (circle one) week / month
Diesel/Heating Oil Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
Diesel/Heating Oil Tank 2	_____ gallons, filled	_____ times per (circle one) week / month
Gasoline Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
Gasoline Tank 2	_____ gallons, filled	_____ times per (circle one) week / month

WINTER (October to March)

AvGas Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
AvGas Tank 2	_____ gallons, filled	_____ times per (circle one) week / month
Diesel/Heating Oil Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
Diesel/Heating Oil Tank 2	_____ gallons, filled	_____ times per (circle one) week / month
Gasoline Tank 1	_____ gallons, filled	_____ times per (circle one) week / month
Gasoline Tank 2	_____ gallons, filled	_____ times per (circle one) week / month

SUMMER AND WINTER SURVEY
Medical Center

FACILITY HEATING/CLIMATE CONTROL

- Please circle the type/s of heater used in the clinic (circle all that apply).

  Wood stove

  Water Heating (hydronic)/Boiler

  Central oil furnace

  Toyo, Monitor heater

  Propane

  Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER	WINTER	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

OTHER MOTORIZED EQUIPMENT

- Please identify the type of motorized equipment, if any, that are used in the premises by indicating the fuel, size/capacity, and how often they are used during each season.

Generator 1 (circle one) Diesel/2-stroke gasoline/4-stroke gasoline/LPG
____ Hp rating, ____ kW capacity
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

Generator 2 (circle one) Diesel/2-stroke gasoline/4-stroke gasoline/LPG
____ Hp rating, ____ kW capacity
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

Water Pump (circle one) Diesel/2-stroke gasoline/4-stroke gasoline/LPG
____ Hp rating
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

CLINIC VEHICLES AND ACTIVITY

- Please identify the types and number of clinic-owned and operated vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/Vans/SUVs	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month

FUEL STORAGE TANKS

- Please indicate the fuel tank sizes located in the premises and their refill frequencies for each season.

SUMMER (April to September)

Diesel/Heating Oil Tank _____ gallons, filled _____ times per (circle one) week / month

Gasoline Tank _____ gallons, filled _____ times per (circle one) week / month

WINTER (October to March)

Diesel/Heating Oil Tank _____ gallons, filled _____ times per (circle one) week / month

Gasoline Tank _____ gallons, filled _____ times per (circle one) week / month

SUMMER AND WINTER SURVEY
Electric Utility

POWER GENERATION

- If the facility uses an Internal Combustion (IC) Reciprocating Engine attached to a Generator, please fill in the following.
  IC Reciprocating Engine Characteristics:

  Rated Horsepower (Hp) _____

  Fuel (circle one) Diesel / Other, please specify_____

  Is it equipped with emission controls? (circle one) Yes / No / Don't Know

  If yes, please specify _____

- If the facility uses a Gas Turbine attached to a Generator, please fill in the following.
  Gas Turbine Engine Characteristics:

  Rated Horsepower (Hp) _____

  Fuel (circle one) Natural Gas / Jet Fuel / Other, please specify_____

  Is it equipped with emission controls? (circle one) Yes / No / Don't Know

  If yes, please specify _____

- Please fill in the following Generator characteristics.

  Rated Output (kW) _____

OTHER MOTORIZED (NON-ELECTRIC) EQUIPMENT

- Please identify the type of motorized equipment, if any, that are used in the premises by indicating the fuel, size/capacity, and how often they are used during each season.

Water Pump (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG
____ Hp rating
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

Air Compressor (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG
____ Hp rating
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

Gas Compressor (circle one) Diesel / 2-Stroke Gasoline / 4-Stroke Gasoline / LPG
____ Hp rating
SUMMER USE: ____ hours per (circle one) day / week / month
WINTER USE: ____ hours per (circle one) day / week / month

FUEL STORAGE TANKS

- Please indicate the fuel tank sizes located in the premises and their refill frequencies for each season.

SUMMER (April to September)

Diesel/Heating Oil Tank _____ gallons, filled _____ times per (circle one) week / month

Gasoline Tank _____ gallons, filled _____ times per (circle one) week / month

WINTER (October to March)

Diesel/Heating Oil Tank _____ gallons, filled _____ times per (circle one) week / month

Gasoline Tank _____ gallons, filled _____ times per (circle one) week / month

FACILITY HEATING/CLIMATE CONTROL

- Please circle the type/s of heater used in the facility (circle all that apply).

Wood stove

Water Heating (hydronic)/Boiler

Central oil furnace

Toyo, Monitor heater

Propane

Other, please specify_____

- Please indicate how often each heater is used during each season (fill any that apply).

	SUMMER (Apr-Sept)	WINTER (Oct-Mar)	UNITS
Wood stove	_____	_____	hours per (circle one) day / week / month
Water Heating (hydronic)/Boiler	_____	_____	hours per (circle one) day / week / month
Central oil furnace	_____	_____	hours per (circle one) day / week / month
Toyo, Monitor heater	_____	_____	hours per (circle one) day / week / month
Propane	_____	_____	hours per (circle one) day / week / month
Other	_____	_____	hours per (circle one) day / week / month

FACILITY VEHICLES AND ACTIVITY

- Please identify the types and number of facility-owned and operated vehicles.

	# of Gasoline-Powered	# of Diesel-Powered
Cars	_____	_____
Pickup Trucks/SUVs	_____	_____
Motorcycles	_____	_____
4-Wheelers	_____	_____
Heavy-Duty Trucks	_____	_____

- Approximately how many miles is each type of vehicle typically driven during each season?

	SUMMER	WINTER	UNITS
Cars	_____	_____	miles per (circle one) day / week / month
Pickup Trucks/SUVs	_____	_____	miles per (circle one) day / week / month
4-Wheelers	_____	_____	miles per (circle one) day / week / month
Heavy-Duty Trucks	_____	_____	miles per (circle one) day / week / month

Appendix C

Community Data and Designations

ALASKA COMMUNITY DATA AND DESIGNATIONS

Community	2005 (5/25/06) Population	Incorp_Type	DEC_LAT	DEC_LONG	CENSUS_AREA	POP_GRP	ON-HWY	Surrogate Used	(1 = yes, 0 = no) Elec Utility	Boat Reg
Adak	167	2nd Class City	51.8725	-176.62861	Aleutians West	Small	No	Sand Point	1	1
Afognak	0	Unincorporated	58.00775	-152.76794	Kodiak Island	Small	No	Sand Point	1	0
Akhiok	41	2nd Class City	56.94556	-154.17028	Kodiak Island	Small	No	Sand Point	1	1
Akiachak	644	Unincorporated	60.90944	-161.43139	Bethel	Small	No	Kongiganak	1	1
Akiak	378	2nd Class City	60.91222	-161.21389	Bethel	Small	No	Kongiganak	1	1
Akutan	773	2nd Class City	54.13556	-165.77306	Aleutians East	Small	No	Sand Point	1	1
Alakanuk	678	2nd Class City	62.68889	-164.61528	Wade Hampton	Small	No	Stebbins	1	1
Alatna	41	Unincorporated	66.56692	-152.66639	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Alcan Border	11	Unincorporated	62.66176	-141.16123	Southeast Fairbanks	Small	No	Northway Village	1	0
Aleknagik	241	2nd Class City	59.27306	-158.61778	Dillingham	Small	No	Sand Point	1	1
Aleneva	46	Unincorporated	58.01418	-152.90944	Kodiak Island	Small	No	Sand Point	1	0
Allakaket	87	2nd Class City	66.56261	-152.64756	Yukon-Koyukuk	Small	No	Huslia	1	1
Alpine	0	Unincorporated	70.32953	-150.96541	North Slope	Small	No	Buckland	1	0
Ambler	283	2nd Class City	67.08611	-157.85139	Northwest Arctic	Small	No	Buckland	1	1
Anaktuvuk Pass	308	2nd Class City	68.14333	-151.73583	North Slope	Small	No	Buckland	1	0
Anchor Point	1767	Unincorporated	59.77667	-151.83139	Kenai Peninsula	Small	Yes	Sand Point	1	1
Anchorage	278241	Unified Home Rule Municipality	61.21806	-149.90028	Anchorage	Large	Yes	***	1	1
Anderson	546	2nd Class City	64.34417	-149.18694	Denali	Small	No	Northway Village	1	1
Andreafsky	145	located in St. Mary's	62.045305	-163.218629	Wade Hampton	Small	No	Stebbins	1	0
Angoon	497	2nd Class City	57.50333	-134.58389	Skagway-Angoon	Small	Yes	Klawock	1	1
Aniak	528	2nd Class City	61.57833	-159.52222	Bethel	Small	No	Kongiganak	1	1
Anvik	99	2nd Class City	62.65611	-160.20667	Yukon-Koyukuk	Small	No	Huslia	1	1
Arctic Village	147	Unincorporated	68.12694	-145.53778	Yukon-Koyukuk	Small	No	***	1	1
Atka	90	2nd Class City	52.19611	-174.20056	Aleutians West	Small	No	Sand Point	1	1
Atmautluak	304	Unincorporated	60.86694	-162.27306	Bethel	Small	No	Kongiganak	1	1
Atqasuk	247	2nd Class City	70.46944	-157.39583	North Slope	Small	No	Buckland	1	1
Attu Station	20	Unincorporated	52.9375	173.2375	Aleutians West	Small	No	Sand Point	1	1
Barrow	4199	1st Class City	71.29056	-156.78861	North Slope	Midsize	No	Buckland	0	1
Bear Creek	1884	Unincorporated	60.21128	-149.3087	Kenai Peninsula	Small	No	Port Graham	1	0
Beaver	64	Unincorporated	66.35944	-147.39639	Yukon-Koyukuk	Small	No	Huslia	1	1
Belkofski	0	Unincorporated	55.098882	-162.035477	Aleutians East	Small	No	Sand Point	1	0
Beluga	21	Unincorporated	61.17191	-151.16826	Kenai Peninsula	Small	No	Sand Point	1	1
Bethel	5960	2nd Class City	60.79222	-161.75583	Bethel	Midsize	Yes	***	1	1
Bettles	31	2nd Class City	66.91788	-151.51513	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Big Delta	738	Unincorporated	64.1525	-145.84222	Southeast Fairbanks	Small	No	Northway Village	1	1
Big Lake	2982	Unincorporated	61.52559	-149.9415	Matanuska-Susitna	Midsize	Yes	Northway Village	0	1
Bill Moore's Slough	0	Unincorporated	62.945434	-163.761425	Wade Hampton	Small	No	Stebbins	1	0
Birch Creek	33	Unincorporated	66.25619	-145.84967	Yukon-Koyukuk	Small	No	Huslia	1	1
Brevig Mission	327	2nd Class City	65.33472	-166.48917	Nome	Small	No	Stebbins	1	1
Buckland	434	2nd Class City	65.97972	-161.12306	Northwest Arctic	Small	No	***	1	1
Buffalo Soapstone	755	Unincorporated	61.71777	-149.09835	Matanuska-Susitna	Small	No	Northway Village	0	0
Butte	3101	Unincorporated	61.54222	-149.03333	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Cantwell	218	Unincorporated	63.39167	-148.95083	Denali	Small	Yes	Northway Village	1	1
Central	97	Unincorporated	65.5725	-144.80306	Yukon-Koyukuk	Small	Yes	Minto	1	1
Chalkyitsik	79	Unincorporated	66.65444	-143.72222	Yukon-Koyukuk	Small	No	Huslia	1	1
Chase	30				Matanuska-Susitna	Small		Northway Village	0	0
Chefornak	457	2nd Class City	60.16	-164.26583	Bethel	Small	No	Kongiganak	1	1
Chenega Bay	82	Unincorporated	60.06571	-148.01038	Valdez-Cordova	Small	No	Port Graham	1	1
Chevak	916	2nd Class City	61.52778	-165.58639	Wade Hampton	Small	No	Stebbins	1	1
Chickaloon	292	Unincorporated	61.79667	-148.46278	Matanuska-Susitna	Small	No	Northway Village	0	1
Chicken	14	Unincorporated	64.07333	-141.93611	Southeast Fairbanks	Small	No	Northway Village	1	1

ALASKA COMMUNITY DATA AND DESIGNATIONS

Community	2005 (5/25/06) Population	Incorp_Type	DEC_LAT	DEC_LONG	CENSUS_AREA	POP_GRP	ON-HWY	Surrogate Used	(1 = yes, 0 = no) Elec Utility	Boat Reg
Chignik	95	2nd Class City	56.29528	-158.40222	Lake & Peninsula	Small	No	Sand Point	1	1
Chignik Lagoon	86	Unincorporated	56.30995	-158.53142	Lake & Peninsula	Small	No	Sand Point	1	1
Chignik Lake	117	Unincorporated	56.25537	-158.76175	Lake & Peninsula	Small	No	Sand Point	1	1
Chiniak	52	Unincorporated	57.61657	-152.16402	Kodiak Island	Small	No	Sand Point	1	1
Chisana	9	Unincorporated	62.06611	-142.04083	Valdez-Cordova	Small	No	Port Graham	1	0
Chistochina	104	Unincorporated	62.565	-144.66472	Valdez-Cordova	Small	No	Port Graham	1	1
Chitina	110	Unincorporated	61.51583	-144.43694	Valdez-Cordova	Small	Yes	Port Graham	1	1
Chuathbaluk	95	2nd Class City	61.57194	-159.245	Bethel	Small	No	Kongiganak	1	1
Chuloonawick	0	Unincorporated	62.927203	-164.079228	Wade Hampton	Small	No	Stebbins	1	0
Circle	90	Unincorporated	65.82556	-144.06056	Yukon-Koyukuk	Small	No	Huslia	1	1
Clam Gulch	172	Unincorporated	60.23111	-151.39361	Kenai Peninsula	Small	Yes	Sand Point	1	1
Clark's Point	65	2nd Class City	58.84417	-158.55083	Dillingham	Small	No	Sand Point	1	1
Coffman Cove	156	2nd Class City	56.01389	-132.82778	Prince of Wales	Small	No	Klawock	1	1
Cohoe	1262	Unincorporated	60.36803	-151.3086	Kenai Peninsula	Small	No	Sand Point	1	0
Cold Bay	89	2nd Class City	55.18583	-162.72111	Aleutians East	Small	No	Sand Point	1	1
Coldfoot	11	Unincorporated	67.25639	-150.18417	Yukon-Koyukuk	Small	No	Arctic Village	1	0
College	12231	Unincorporated	64.85694	-147.80278	Fairbanks North Star	Midsize	No	***	1	0
Cooper Landing	344	Unincorporated	60.49	-149.83417	Kenai Peninsula	Small	No	Port Graham	1	1
Copper Center	452	Unincorporated	61.955	-145.30528	Valdez-Cordova	Small	Yes	Port Graham	1	1
Copperville	185	Unincorporated	62.07231	-145.41387	Valdez-Cordova	Small	No	Port Graham	1	0
Cordova	2288	Home Rule City	60.54278	-145.7575	Valdez-Cordova	Midsize	Yes	Port Graham	0	1
Council	0	Unincorporated	64.890706	-163.673088	Nome	Small	No	Stebbins	1	1
Covenant Life	252	Unincorporated	59.39907	-136.0783	Haines	Small	No	Klawock	1	0
Craig	1102	1st Class City	55.47639	-133.14833	Prince of Wales	Small	Yes	Klawock	1	1
Crooked Creek	145	Unincorporated	61.87	-158.11083	Bethel	Small	No	Kongiganak	1	1
Crown Point	82	Unincorporated	60.42222	-149.36667	Kenai Peninsula	Small	No	Port Graham	1	0
Cube Cove	0	Unincorporated	57.94063	-134.73911	Skagway-Angoon	Small	No	Klawock	1	0
Deering	139	2nd Class City	66.07497	-162.71274	Northwest Arctic	Small	No	Buckland	1	1
Delta Junction	1047	2nd Class City	64.03778	-145.73222	Southeast Fairbanks	Small	Yes	Northway Village	0	1
Deltana	1939	Unincorporated	63.85371	-145.22307	Southeast Fairbanks	Small	No	Northway Village	1	0
Diamond Ridge	732	Unincorporated	59.69904	-151.56071	Kenai Peninsula	Small	No	Sand Point	1	0
Dillingham	2370	1st Class City	59.03972	-158.4575	Dillingham	Midsize	Yes	***	1	1
Diomede	132	2nd Class City	65.758611	-168.953056	Nome	Small	No	Stebbins	1	1
Dot Lake	27	Unincorporated	63.58518	-144.16992	Southeast Fairbanks	Small	No	Northway Village	1	1
Dot Lake Village	33	Unincorporated	63.65864	-144.01413	Southeast Fairbanks	Small	No	Northway Village	1	0
Douglas	5082	located in Juneau	58.298947	-134.452699	Juneau	Midsize	Yes	***	1	1
Dry Creek	107	Unincorporated	63.61961	-144.61189	Southeast Fairbanks	Small	No	Northway Village	1	0
Eagle	137	2nd Class City	64.78806	-141.2	Southeast Fairbanks	Small	No	Northway Village	1	1
Eagle River-Chugiak	30000	located in Anchorage	61.32222	-149.56667	Anchorage	Midsize	Yes	***	1	1
Eagle Village	78	Unincorporated	64.78056	-141.11361	Southeast Fairbanks	Small	Yes	Northway Village	1	0
Edna Bay	41	Unincorporated	55.94889	-133.66222	Prince of Wales	Small	No	Klawock	1	1
Eek	291	2nd Class City	60.21889	-162.02444	Bethel	Small	No	Kongiganak	1	1
Egegik	81	2nd Class City	58.21556	-157.37583	Lake & Peninsula	Small	No	Sand Point	1	1
Eielson AFB	4552	Unincorporated	64.66444	-147.09944	Fairbanks North Star	Midsize	No	***	1	1
Eklutna	383	located in Anchorage	61.454528	-149.354478	Anchorage	Small	Yes	***	1	1
Ekuk	0	Unincorporated	58.814986	-158.557684	Dillingham	Small	No	Sand Point	1	1
Ekwok	118	2nd Class City	59.34972	-157.47528	Dillingham	Small	No	Sand Point	1	1
Elfin Cove	29	Unincorporated	58.19444	-136.34333	Skagway-Angoon	Small	No	Klawock	1	1
Elim	302	2nd Class City	64.6175	-162.26056	Nome	Small	No	Stebbins	1	1
Emmonak	740	2nd Class City	62.77778	-164.52306	Wade Hampton	Small	No	Stebbins	1	1
Ester	1841	Unincorporated	64.84722	-148.01444	Fairbanks North Star	Small	No	***	1	1

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Evansville	20	Unincorporated	66.92491	-151.5061	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Excursion Inlet	9	Unincorporated	58.42139	-135.43667	Haines	Small	No	Klawock	1	1
Eyak	145	located in Cordova	60.525059	-145.628293	Valdez-Cordova	Small	No	Port Graham	1	0
Fairbanks	31182	Home Rule City	64.83778	-147.71639	Fairbanks North Star	Large	Yes	***	1	1
False Pass	63	2nd Class City	54.85394	-163.40883	Aleutians East	Small	No	Sand Point	1	1
Farm Loop	1193	Unincorporated	61.63557	-149.13879	Matanuska-Susitna	Small	No	Northway Village	0	0
Ferry	36	Unincorporated	64.03708	-148.9445	Denali	Small	No	Northway Village	1	0
Fishhook	2784	Unincorporated	61.7562	-149.22467	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Flat	0	Unincorporated	62.45361	-158.0075	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Fort Greely	197	Unincorporated	63.8567	-145.85236	Southeast Fairbanks	Small	No	Northway Village	1	1
Fort Yukon	570	2nd Class City	66.56472	-145.27389	Yukon-Koyukuk	Small	No	Huslia	1	1
Four Mile Road	31	Unincorporated	64.60028	-149.11793	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Fox	377	Unincorporated	64.95806	-147.61833	Fairbanks North Star	Small	Yes	***	1	0
Fox River	612	Unincorporated	59.8616	-151.01966	Kenai Peninsula	Small	No	Sand Point	1	0
Fritz Creek	1775	Unincorporated	59.74842	-151.2778	Kenai Peninsula	Small	No	Sand Point	1	1
Funny River	747	Unincorporated	60.48268	-150.84631	Kenai Peninsula	Small	No	Sand Point	1	0
Gakona	214	Unincorporated	62.30194	-145.30194	Valdez-Cordova	Small	Yes	Port Graham	1	1
Galena	654	1st Class City	64.73333	-156.9275	Yukon-Koyukuk	Small	No	Huslia	1	1
Gambell	660	2nd Class City	63.77972	-171.74111	Nome	Small	No	Stebbins	1	1
Game Creek	21	Unincorporated	58.05809	-135.51478	Skagway-Angoon	Small	No	Klawock	1	0
Gateway	3682	Unincorporated	61.57363	-149.25849	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Georgetown	3	Unincorporated	61.923381	-157.61984	Bethel	Small	No	Arctic Village	1	0
Girdwood	1850	located in Anchorage	60.94167	-149.16667	Anchorage	Small	Yes	***	1	1
Glacier View	264	Unincorporated	61.94864	-147.22641	Matanuska-Susitna	Small	No	Northway Village	0	0
Glennallen	589	Unincorporated	62.10917	-145.54639	Valdez-Cordova	Small	Yes	Port Graham	1	1
Golovin	150	2nd Class City	64.54333	-163.02917	Nome	Small	No	Stebbins	1	1
Goodnews Bay	238	2nd Class City	59.11889	-161.5875	Bethel	Small	No	Kongiganak	1	1
Grayling	171	2nd Class City	62.90361	-160.06472	Yukon-Koyukuk	Small	No	Huslia	1	1
Gulkana	101	Unincorporated	62.27139	-145.38222	Valdez-Cordova	Small	No	Port Graham	1	1
Gustavus	459	Unincorporated	58.41333	-135.73694	Skagway-Angoon	Small	Yes	Klawock	1	1
Haines	1525	Unincorporated	59.23583	-135.445	Haines	Small	Yes	Klawock	1	1
Halibut Cove	23	Unincorporated	59.595	-151.225	Kenai Peninsula	Small	No	Sand Point	1	1
Hamilton	0	Unincorporated	62.894577	-163.842871	Wade Hampton	Small	No	Stebbins	1	0
Happy Valley	477	Unincorporated	59.93583	-151.73722	Kenai Peninsula	Small	Yes	Sand Point	1	0
Harding-Birch Lakes	237	Unincorporated	64.36943	-146.59941	Fairbanks North Star	Small	No	***	1	0
Healy	1012	Unincorporated	63.85694	-148.96611	Denali	Small	Yes	Northway Village	0	1
Healy Lake	29	Unincorporated	64.02689	-144.66162	Southeast Fairbanks	Small	No	Northway Village	1	0
Hobart Bay	3	Unincorporated	57.43577	-133.34062	Skagway-Angoon	Small	No	Klawock	1	0
Hollis	137	Unincorporated	55.48389	-132.6675	Prince of Wales	Small	Yes	Klawock	1	1
Holy Cross	205	2nd Class City	62.19944	-159.77139	Yukon-Koyukuk	Small	No	Huslia	1	1
Homer	5435	1st Class City	59.6425	-151.54833	Kenai Peninsula	Midsize	Yes	Dillingham	1	1
Hoonah	861	1st Class City	58.11	-135.44361	Skagway-Angoon	Small	Yes	Klawock	1	1
Hooper Bay	1133	2nd Class City	61.53111	-166.09667	Wade Hampton	Small	No	Stebbins	1	1
Hope	139	Unincorporated	60.92028	-149.64028	Kenai Peninsula	Small	No	Port Graham	1	1
Houston	1447	2nd Class City	61.63028	-149.81806	Matanuska-Susitna	Small	No	Northway Village	0	1
Hughes	69	2nd Class City	66.04889	-154.25556	Yukon-Koyukuk	Small	No	Huslia	1	1
Huslia	265	2nd Class City	65.69861	-156.39972	Yukon-Koyukuk	Small	No	***	1	1
Hydaburg	369	1st Class City	55.20806	-132.82667	Prince of Wales	Small	Yes	Klawock	1	1
Hyder	91	Unincorporated	55.91694	-130.02472	Prince of Wales	Small	Yes	Klawock	1	1
Igiugig	50	Unincorporated	59.32778	-155.89472	Lake & Peninsula	Small	No	Sand Point	1	1
Iliamna	86	Unincorporated	59.75472	-154.90611	Lake & Peninsula	Small	No	Sand Point	1	1

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Ivanof Bay	2	Unincorporated	55.91123	-159.48612	Lake & Peninsula	Small	No	Sand Point	1	1
Jakolof Bay	39	Unincorporated	59.45305	-151.52114	Kenai Peninsula	Small	No	Sand Point	1	0
Juneau	31193	Unified Home Rule Municipality	58.30194	-134.41972	Juneau	Large	Yes	***	1	1
Kachemak	457	2nd Class City	59.67	-151.43417	Kenai Peninsula	Small	No	Sand Point	1	0
Kaguyak	0	Unincorporated	56.85942	-153.76695	Kodiak Island	Small	No	Sand Point	1	0
Kake	598	1st Class City	56.97583	-133.94722	Wrangell-Petersburg	Small	Yes	Klawock	1	1
Kaktovik	276	2nd Class City	70.13194	-143.62389	North Slope	Small	No	Buckland	1	1
Kalifornsky	6748	Unincorporated	60.41833	-151.29	Kenai Peninsula	Midsize	No	Dillingham	1	0
Kaltag	227	2nd Class City	64.32722	-158.72194	Yukon-Koyukuk	Small	No	Huslia	1	1
Kanatak	0	Unincorporated	57.56667	-156.03333	Kodiak Island	Small	No	Sand Point	1	0
Karluk	27	Unincorporated	57.57021	-154.45433	Kodiak Island	Small	No	Sand Point	1	1
Kasaan	61	2nd Class City	55.54006	-132.4022	Prince of Wales	Small	Yes	Klawock	1	1
Kasigluk	534	Unincorporated	60.89506	-162.51799	Bethel	Small	No	Kongiganak	1	1
Kasilof	526	Unincorporated	60.33692	-151.27665	Kenai Peninsula	Small	Yes	Sand Point	1	1
Kenai	6777	Home Rule City	60.55444	-151.25833	Kenai Peninsula	Midsize	Yes	Dillingham	1	1
Kenny Lake	417	Unincorporated	61.68361	-144.85234	Valdez-Cordova	Small	No	Port Graham	1	1
Ketchikan	7685	Home Rule City	55.34222	-131.64611	Ketchikan Gateway	Midsize	Yes	Sitka	0	1
Kiana	380	2nd Class City	66.975	-160.42278	Northwest Arctic	Small	No	Buckland	1	1
King Cove	723	1st Class City	55.06167	-162.31028	Aleutians East	Small	No	Sand Point	1	1
King Island	0	Unincorporated	64.96937	-168.06493	Nome	Small	No	Stebbins	1	0
King Salmon	420	Unincorporated	58.68833	-156.66139	Bristol Bay	Small	No	Sand Point	1	1
Kipnuk	688	Unincorporated	59.93889	-164.04139	Bethel	Small	No	Kongiganak	1	1
Kivalina	385	2nd Class City	67.72694	-164.53333	Northwest Arctic	Small	No	Buckland	1	1
Klawock	780	1st Class City	55.55222	-133.09583	Prince of Wales	Small	Yes	***	1	1
Klukwan	109	Unincorporated	59.3996	-135.89331	Skagway-Angoon	Small	Yes	Klawock	1	0
Knik River	632	Unincorporated	61.47097	-148.86064	Matanuska-Susitna	Small	No	Northway Village	0	0
Knik-Fairview	10271	Unincorporated	61.54078	-149.59373	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Kobuk	130	2nd Class City	66.90857	-156.88102	Northwest Arctic	Small	No	Buckland	1	1
Kodiak	6088	Home Rule City	57.78889	-152.4019	Kodiak Island	Midsize	Yes	Dillingham	0	0
Kodiak Station	1975	Unincorporated	57.73813	-152.50368	Kodiak Island	Small	No	Sand Point	1	1
Kokhanok	179	Unincorporated	59.4416	-154.75514	Lake & Peninsula	Small	No	Sand Point	1	1
Koliganek	167	Unincorporated	59.72861	-157.28444	Dillingham	Small	No	Sand Point	1	1
Kongiganak	427	Unincorporated	59.88	-163.054	Bethel	Small	No	***	1	1
Kotlik	609	2nd Class City	63.03417	-163.55333	Wade Hampton	Small	No	Stebbins	1	1
Kotzebue	3120	2nd Class City	66.89828	-162.59585	Northwest Arctic	Midsize	No	Buckland	0	1
Koyuk	350	2nd Class City	64.93194	-161.15694	Nome	Small	No	Stebbins	1	1
Koyukuk	97	2nd Class City	64.88093	-157.70103	Yukon-Koyukuk	Small	No	Huslia	1	1
Kupreanof	37	2nd Class City	56.81444	-132.98056	Wrangell-Petersburg	Small	No	Klawock	1	0
Kwethluk	721	2nd Class City	60.81222	-161.43583	Bethel	Small	No	Kongiganak	1	1
Kwigillingok	361	Unincorporated	59.86393	-163.13322	Bethel	Small	No	Kongiganak	1	1
Lake Louise	91	Unincorporated	62.28218	-146.54385	Matanuska-Susitna	Small	No	Northway Village	0	0
Lake Minchumina	19	Unincorporated	63.88278	-152.31222	Yukon-Koyukuk	Small	No	Huslia	1	1
Lakes	7773	Unincorporated	61.60696	-149.30545	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Larsen Bay	97	2nd Class City	57.53854	-153.97844	Kodiak Island	Small	No	Sand Point	1	1
Lazy Mountain	1238	Unincorporated	61.64779	-148.96363	Matanuska-Susitna	Small	No	Northway Village	0	0
Levelock	54	Unincorporated	59.115	-156.85667	Lake & Peninsula	Small	No	Sand Point	1	1
Lime Village	28	Unincorporated	61.35639	-155.43556	Bethel	Small	No	Arctic Village	1	0
Livengood	28	Unincorporated	65.52444	-148.54472	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Lowell Point	96	Unincorporated	60.07143	-149.43436	Kenai Peninsula	Small	No	Port Graham	1	0
Lower Kalskag	252	2nd Class City	61.51222	-160.35806	Bethel	Small	No	Kongiganak	1	1
Lutak	36	Unincorporated	59.38269	-135.64291	Haines	Small	No	Klawock	1	0

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Manley Hot Springs	74	Unincorporated	65.00111	-150.63389	Yukon-Koyukuk	Small	Yes	Minto	1	1
Manokotak	437	2nd Class City	58.98139	-159.05833	Dillingham	Small	No	Sand Point	1	1
Marshall	370	2nd Class City	61.87778	-162.08111	Wade Hampton	Small	No	Stebbins	1	1
Mary's Igloo	0	Unincorporated	65.141898	-165.043931	Nome	Small	No	Stebbins	1	0
McCarthy	70	Unincorporated	61.43333	-142.92167	Valdez-Cordova	Small	No	Port Graham	1	1
McGrath	347	2nd Class City	62.95639	-155.59583	Yukon-Koyukuk	Small	No	Huslia	1	1
McKinley Park	139	Unincorporated	63.73278	-148.91417	Denali	Small	No	Northway Village	1	1
Meadow Lakes	6332	Unincorporated	61.61579	-149.58254	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Mekoryuk	192	2nd Class City	60.38806	-166.185	Bethel	Small	No	Kongiganak	1	1
Mendeltna	72	Unincorporated	62.04944	-146.53833	Valdez-Cordova	Small	No	Port Graham	1	0
Mentasta Lake	126	Unincorporated	62.93155	-143.79273	Valdez-Cordova	Small	No	Port Graham	1	1
Metlakatla	1397	Federal Law (Indian Reservation)	55.12959	-131.57496	Prince of Wales	Small	No	Klawock	1	1
Meyers Chuck	15	Unincorporated	55.74083	-132.25639	Prince of Wales	Small	No	Klawock	1	1
Miller Landing	0	located in Homer	59.66589	-151.43787	Kenai Peninsula	Small	No	Sand Point	1	0
Minto	202	Unincorporated	65.15333	-149.33694	Yukon-Koyukuk	Small	Yes	***	1	1
Moose Creek	648	Unincorporated	64.71	-147.14361	Fairbanks North Star	Small	No	***	1	0
Moose Pass	218	Unincorporated	60.4875	-149.36889	Kenai Peninsula	Small	Yes	Port Graham	1	1
Mosquito Lake	163	Unincorporated	59.4735	-136.14671	Haines	Small	No	Klawock	1	0
Mountain Village	786	2nd Class City	62.08556	-163.72944	Wade Hampton	Small	No	Stebbins	1	1
Mud Bay	140	Unincorporated	59.1655	-135.37792	Haines	Small	No	Klawock	1	0
Naknek	577	Unincorporated	58.72833	-157.01389	Bristol Bay	Small	No	Sand Point	1	1
Nanwalek	222	Unincorporated	59.35639	-151.92083	Kenai Peninsula	Small	No	Sand Point	1	1
Napaimute	0	Unincorporated	61.532364	-158.634949	Bethel	Small	No	Kongiganak	1	0
Napakiak	373	2nd Class City	60.69667	-161.95194	Bethel	Small	No	Kongiganak	1	1
Napaskiak	428	2nd Class City	60.70806	-161.76611	Bethel	Small	No	Kongiganak	1	1
Naukati Bay	106	Unincorporated	55.88077	-133.195	Prince of Wales	Small	No	Klawock	1	1
Nelchina	67	Unincorporated	61.99052	-146.7704	Valdez-Cordova	Small	No	Port Graham	1	0
Nelson Lagoon	70	Unincorporated	56.00194	-161.20278	Aleutians East	Small	No	Sand Point	1	1
Nenana	549	Home Rule City	64.56389	-149.09306	Yukon-Koyukuk	Small	Yes	Minto	0	1
New Allakaket	32	Unincorporated	66.54268	-152.64769	Yukon-Koyukuk	Small	No	Arctic Village	1	0
New Stuyahok	461	2nd Class City	59.45278	-157.31194	Dillingham	Small	No	Sand Point	1	1
Newhalen	180	2nd Class City	59.72	-154.89722	Lake & Peninsula	Small	No	Sand Point	1	0
Newtok	315	Unincorporated	60.94278	-164.62944	Bethel	Small	No	Kongiganak	1	1
Nightmute	234	2nd Class City	60.47944	-164.72389	Bethel	Small	No	Kongiganak	1	1
Nikiski	4187	Unincorporated	60.71605	-151.34066	Kenai Peninsula	Midsize	No	Dillingham	1	1
Nikolaevsk	304	Unincorporated	59.81194	-151.61056	Kenai Peninsula	Small	No	Sand Point	1	1
Nikolai	109	2nd Class City	63.01333	-154.375	Yukon-Koyukuk	Small	No	Huslia	1	1
Nikolski	31	Unincorporated	52.93806	-168.86778	Aleutians West	Small	No	Sand Point	1	1
Ninilchik	785	Unincorporated	60.05139	-151.66889	Kenai Peninsula	Small	Yes	Sand Point	1	1
Noatak	473	Unincorporated	67.57111	-162.96528	Northwest Arctic	Small	No	Buckland	1	1
Nome	3508	1st Class City	64.50111	-165.40639	Nome	Midsize	No	Bethel	0	1
Nondalton	203	2nd Class City	59.97185	-154.84779	Lake & Peninsula	Small	No	Sand Point	1	1
Noorvik	628	2nd Class City	66.83833	-161.03278	Northwest Arctic	Small	No	Buckland	1	1
North Pole	1595	Home Rule City	64.75111	-147.34944	Fairbanks North Star	Small	Yes	***	0	1
Northway	87	Unincorporated	62.96167	-141.93722	Southeast Fairbanks	Small	Yes	Northway Village	1	1
Northway Junction	78	Unincorporated	63.01306	-141.80306	Southeast Fairbanks	Small	No	Northway Village	1	0
Northway Village	99	Unincorporated	62.98222	-141.95167	Southeast Fairbanks	Small	No	***	1	0
Nuiqsut	411	2nd Class City	70.2175	-150.97639	North Slope	Small	No	Buckland	1	1
Nulato	310	2nd Class City	64.71944	-158.10306	Yukon-Koyukuk	Small	No	Huslia	1	1
Nunam Iqua	204	2nd Class City	62.53361	-164.84111	Wade Hampton	Small	No	Stebbins	1	1
Nunam Iqua	204	2nd Class City	62.53361	-164.84111	Wade Hampton	Small	No	Stebbins	1	1

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Nunapitchuk	516	2nd Class City	60.89689	-162.45683	Bethel	Small	No	Kongiganak	1	1
Ohogamiut	0	Unincorporated	61.592798	-161.875456	Wade Hampton	Small	No	Stebbins	1	0
Old Harbor	200	2nd Class City	57.20278	-153.30389	Kodiak Island	Small	No	Sand Point	1	1
Oscarville	59	Unincorporated	60.72278	-161.77	Bethel	Small	No	Kongiganak	1	1
Ouzinkie	191	2nd Class City	57.92361	-152.50222	Kodiak Island	Small	No	Sand Point	1	1
Paimiut	2	Unincorporated	61.70139	-165.83944	Wade Hampton	Small	No	Stebbins	1	0
Palmer	5382	Home Rule City	61.59972	-149.11278	Matanuska-Susitna	Midsize	Yes	Northway Village	0	1
Pauloff Harbor	0	Unincorporated	54.45885	-162.70036	Aleutians East	Small	No	Sand Point	1	0
Paxson	37	Unincorporated	63.03333	-145.49167	Valdez-Cordova	Small	No	Port Graham	1	1
Pedro Bay	62	Unincorporated	59.78722	-154.10611	Lake & Peninsula	Small	No	Sand Point	1	1
Pelican	115	1st Class City	57.96083	-136.2275	Skagway-Angoon	Small	No	Klawock	1	1
Perryville	114	Unincorporated	55.91278	-159.14556	Lake & Peninsula	Small	No	Sand Point	1	1
Petersburg	3155	Home Rule City	56.8125	-132.95556	Wrangell-Petersburg	Midsize	Yes	Sitka	1	1
Petersville	16	Unincorporated	62.49639	-150.76556	Matanuska-Susitna	Small	No	Northway Village	0	0
Pilot Point	73	2nd Class City	57.56417	-157.57917	Lake & Peninsula	Small	No	Sand Point	1	1
Pilot Station	565	2nd Class City	61.93889	-162.875	Wade Hampton	Small	No	Stebbins	1	1
Pitka's Point	103	Unincorporated	62.03278	-163.28778	Wade Hampton	Small	No	Stebbins	1	0
Platinum	38	2nd Class City	59.01306	-161.81639	Bethel	Small	No	Kongiganak	1	1
Pleasant Valley	695	Unincorporated	64.89003	-146.88745	Fairbanks North Star	Small	No	***	1	0
Point Baker	22	Unincorporated	56.35278	-133.62111	Prince of Wales	Small	No	Klawock	1	1
Point Hope	702	2nd Class City	68.34778	-166.80806	North Slope	Small	No	Buckland	1	1
Point Lay	238	Unincorporated	69.73586	-163.01178	North Slope	Small	No	Buckland	1	1
Point MacKenzie	244	Unincorporated	61.33767	-150.04456	Matanuska-Susitna	Small	No	Northway Village	0	0
Pope-Vannoy Landing	6	Unincorporated	59.55682	-154.49271	Lake & Peninsula	Small	No	Sand Point	1	0
Port Alexander	75	2nd Class City	56.24972	-134.64444	Wrangell-Petersburg	Small	No	Klawock	1	1
Port Alsworth	106	Unincorporated	60.2025	-154.31278	Lake & Peninsula	Small	No	Sand Point	1	1
Port Clarence	25	Unincorporated	65.26222	-166.84583	Nome	Small	No	Stebbins	1	0
Port Graham	134	Unincorporated	59.35139	-151.82972	Kenai Peninsula	Small	No	***	1	1
Port Heiden	89	2nd Class City	56.94839	-158.62902	Lake & Peninsula	Small	No	Sand Point	1	1
Port Lions	220	2nd Class City	57.8675	-152.88222	Kodiak Island	Small	No	Sand Point	1	1
Port Protection	54	Unincorporated	56.32194	-133.60944	Prince of Wales	Small	No	Klawock	1	1
Port William	0	Unincorporated	58.48333	-152.58333	Kodiak Island	Small	No	Sand Point	1	1
Portage Creek	37	Unincorporated	58.90016	-157.66153	Dillingham	Small	No	Sand Point	1	1
Primrose	84	Unincorporated	60.34361	-149.34417	Kenai Peninsula	Small	No	Port Graham	1	0
Prudhoe Bay	2	Unincorporated	70.25528	-148.33722	North Slope	Small	No	Buckland	1	1
Prudhoe Bay	2	Unincorporated	70.25528	-148.33722	North Slope	Small	No	Buckland	1	1
Quinhagak	642	2nd Class City	59.74889	-161.91583	Bethel	Small	No	Kongiganak	1	1
Rampart	16	Unincorporated	65.505	-150.17	Yukon-Koyukuk	Small	No	Huslia	1	1
Red Devil	36	Unincorporated	61.76111	-157.3125	Bethel	Small	No	Huslia	1	1
Red Dog Mine	33	Unincorporated	68.07184	-162.89091	Northwest Arctic	Small	No	Buckland	1	0
Ridgeway	2062	Unincorporated	60.52888	-151.03677	Kenai Peninsula	Midsize	No	Dillingham	1	0
Ruby	185	2nd Class City	64.73944	-155.48694	Yukon-Koyukuk	Small	No	Huslia	1	1
Russian Mission	329	2nd Class City	61.785	-161.32028	Wade Hampton	Small	No	Stebbins	1	1
Saint George	128	2nd Class City	56.6	-169.54167	Aleutians West	Small	No	Sand Point	1	1
Saint Mary's	570	1st Class City	62.05306	-163.16583	Wade Hampton	Small	No	Stebbins	1	1
Saint Michael	427	2nd Class City	63.47806	-162.03917	Nome	Small	No	Stebbins	1	1
Saint Paul	488	2nd Class City	57.12222	-170.275	Aleutians West	Small	No	Sand Point	1	1
Salamatof	906	Unincorporated	60.61889	-151.3425	Kenai Peninsula	Small	No	Sand Point	1	0
Salcha	953	Unincorporated	64.52954	-146.86473	Fairbanks North Star	Small	No	***	1	1
Sand Point	939	1st Class City	55.33972	-160.49722	Aleutians East	Small	No	***	1	1
Savoonga	695	2nd Class City	63.69417	-170.47889	Nome	Small	No	Stebbins	1	1

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Saxman	405	2nd Class City	55.31833	-131.59583	Ketchikan Gateway	Small	No	Klawock	1	1
Scammon Bay	509	2nd Class City	61.84278	-165.58167	Wade Hampton	Small	No	Stebbins	1	1
Selawik	830	2nd Class City	66.60389	-160.00694	Northwest Arctic	Small	No	Buckland	1	1
Seldovia	287	1st Class City	59.43806	-151.71139	Kenai Peninsula	Small	No	Sand Point	1	0
Seldovia Village	148	Unincorporated	59.4426	-151.70773	Kenai Peninsula	Small	No	Sand Point	1	1
Seward	2606	Home Rule City	60.10417	-149.44222	Kenai Peninsula	Midsize	Yes	Port Graham	1	1
Shageluk	129	2nd Class City	62.68222	-159.56194	Yukon-Koyukuk	Small	No	Huslia	1	1
Shaktoolik	224	2nd Class City	64.33389	-161.15389	Nome	Small	No	Stebbins	1	1
Shemya Station	27	Unincorporated	52.72458	174.11205	Aleutians West	Small	No	Sand Point	1	1
Shishmaref	581	2nd Class City	66.25667	-166.07194	Nome	Small	No	Stebbins	1	1
Shungnak	259	2nd Class City	66.88806	-157.13639	Northwest Arctic	Small	No	Buckland	1	1
Silver Springs	107	Unincorporated	62.01788	-145.34499	Valdez-Cordova	Small	No	Port Graham	1	0
Sitka	8947	Unified Home Rule Municipality	57.05306	-135.33	Sitka	Midsize	Yes	***	1	1
Skagway	834	1st Class City	59.45833	-135.31389	Skagway-Angoon	Small	Yes	Klawock	1	1
Skwentna	75	Unincorporated	61.95861	-151.18111	Matanuska-Susitna	Small	No	Northway Village	0	1
Slana	103	Unincorporated	62.70694	-143.96111	Valdez-Cordova	Small	No	Port Graham	1	1
Sleetmute	92	Unincorporated	61.7025	-157.16972	Bethel	Small	No	Huslia	1	1
Soldotna	3869	1st Class City	60.48778	-151.05833	Kenai Peninsula	Midsize	No	Dillingham	1	1
Solomon	8	Unincorporated	64.56083	-164.43917	Nome	Small	No	Stebbins	1	0
South Naknek	76	Unincorporated	58.71556	-156.99806	Bristol Bay	Small	No	Sand Point	1	1
Stebbins	596	2nd Class City	63.52222	-162.28806	Nome	Small	No	***	1	1
Sterling	4983	Unincorporated	60.53722	-150.76472	Kenai Peninsula	Midsize	No	Dillingham	1	1
Stevens Village	68	Unincorporated	66.00639	-149.09083	Yukon-Koyukuk	Small	No	Huslia	1	1
Stony River	42	Unincorporated	61.78306	-156.58806	Bethel	Small	No	Arctic Village	1	0
Sunrise	24	Unincorporated	60.88972	-149.42111	Kenai Peninsula	Small	No	Port Graham	1	0
Susitna	22	Unincorporated	61.41668	-150.59917	Matanuska-Susitna	Small	No	Northway Village	0	0
Sutton-Alpine	1265	Unincorporated	61.79664	-148.84528	Matanuska-Susitna	Small	Yes	Northway Village	0	1
Takotna	39	Unincorporated	62.98861	-156.06417	Yukon-Koyukuk	Small	No	Huslia	1	1
Talkeetna	873	Unincorporated	62.32389	-150.10944	Matanuska-Susitna	Small	Yes	Northway Village	0	1
Tanacross	149	Unincorporated	63.38528	-143.34639	Southeast Fairbanks	Small	Yes	Northway Village	1	1
Tanaina	6622	Unincorporated	61.66384	-149.43106	Matanuska-Susitna	Midsize	No	Northway Village	0	0
Tanana	281	1st Class City	65.17194	-152.07889	Yukon-Koyukuk	Small	No	Huslia	1	1
Tatitlek	102	Unincorporated	60.86472	-146.67861	Valdez-Cordova	Small	No	Port Graham	1	1
Tazlina	186	Unincorporated	62.05079	-145.43588	Valdez-Cordova	Small	No	Port Graham	1	0
Telida	2	Unincorporated	63.38389	-153.28222	Yukon-Koyukuk	Small	No	Arctic Village	1	0
Teller	263	2nd Class City	65.26361	-166.36083	Nome	Small	No	Stebbins	1	1
Tenakee Springs	98	2nd Class City	57.78083	-135.21889	Skagway-Angoon	Small	No	Klawock	1	1
Tetlin	150	Unincorporated	63.13722	-142.51611	Southeast Fairbanks	Small	Yes	Northway Village	1	1
Thom's Place	9	Unincorporated	56.19467	-132.21179	Wrangell-Petersburg	Small	No	Klawock	1	0
Thorne Bay	486	2nd Class City	55.68778	-132.52222	Prince of Wales	Small	Yes	Klawock	1	1
Togiak	779	2nd Class City	59.06194	-160.37639	Dillingham	Small	No	Sand Point	1	1
Tok	1459	Unincorporated	63.33667	-142.98556	Southeast Fairbanks	Small	Yes	Northway Village	1	1
Toksook Bay	596	2nd Class City	60.53028	-165.1025	Bethel	Small	No	Kongiganak	1	1
Tolsona	20	Unincorporated	62.08899	-146.09968	Valdez-Cordova	Small	No	Port Graham	1	0
Tonsina	95	Unincorporated	61.65583	-145.17528	Valdez-Cordova	Small	No	Port Graham	1	0
Trapper Creek	436	Unincorporated	62.31667	-150.23139	Matanuska-Susitna	Small	No	Northway Village	0	1
Tuluksak	466	Unincorporated	61.1025	-160.96167	Bethel	Small	No	Kongiganak	1	1
Tuntutuliak	399	Unincorporated	60.34306	-162.66306	Bethel	Small	No	Kongiganak	1	1
Tununak	328	Unincorporated	60.58513	-165.25549	Bethel	Small	No	Kongiganak	1	1
Twin Hills	71	Unincorporated	59.07917	-160.275	Dillingham	Small	No	Sand Point	1	1
Two Rivers	623	Unincorporated	64.87222	-147.03833	Fairbanks North Star	Small	No	***	1	1

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Tyonek	199	Unincorporated	61.06806	-151.13694	Kenai Peninsula	Small	No	Sand Point	1	1
Uganik	0				Kodiak Island	Small		Sand Point	1	0
Ugashik	15	Unincorporated	57.51306	-157.3975	Lake & Peninsula	Small	No	Sand Point	1	1
Umkumiute	0	Unincorporated	60.49832	-165.19885	Bethel	Small	No	Kongiganak	1	0
Unalakleet	710	2nd Class City	63.87306	-160.78806	Nome	Small	No	Stebbins	1	1
Unalaska	4297	1st Class City	53.87361	-166.53667	Aleutians West	Midsize	Yes	Dillingham	1	1
Unga	0	Unincorporated	55.18277	-160.50635	Aleutians East	Small	No	Sand Point	1	0
Upper Kalskag	276	2nd Class City	61.53766	-160.30721	Bethel	Small	No	Kongiganak	1	0
Valdez	4454	Home Rule City	61.13083	-146.34833	Valdez-Cordova	Midsize	Yes	Port Graham	1	1
Venetie	184	Unincorporated	67.01389	-146.41861	Yukon-Koyukuk	Small	No	Huslia	1	1
Wainwright	520	2nd Class City	70.63694	-160.03833	North Slope	Small	No	Buckland	1	1
Wales	151	2nd Class City	65.60917	-168.0875	Nome	Small	No	Stebbins	1	1
Wasilla	6413	1st Class City	61.58139	-149.43944	Matanuska-Susitna	Midsize	Yes	Northway Village	0	1
Whale Pass	76	Unincorporated	56.11528	-133.12083	Prince of Wales	Small	Yes	Klawock	1	1
White Mountain	224	2nd Class City	64.68139	-163.40556	Nome	Small	No	Stebbins	1	1
Whitestone Logging Camp	3	Unincorporated	58.0574	-135.40562	Skagway-Angoon	Small	No	Klawock	1	0
Whittier	188	2nd Class City	60.77306	-148.68389	Valdez-Cordova	Small	No	Port Graham	1	1
Willow	1932	Unincorporated	61.74722	-150.0375	Matanuska-Susitna	Small	Yes	Northway Village	0	1
Willow Creek	185	Unincorporated	61.81972	-145.21222	Valdez-Cordova	Small	No	Port Graham	1	0
Wiseman	17	Unincorporated	67.41	-150.1075	Yukon-Koyukuk	Small	No	Huslia	1	1
Womens Bay	703	Unincorporated	57.6936	-152.62291	Kodiak Island	Small	No	Sand Point	1	0
Woody Island	0	Unincorporated	57.78	-152.35522	Kodiak Island	Small	No	Sand Point	1	0
Wrangell	1974	Home Rule City	56.47083	-132.37667	Wrangell-Petersburg	Small	Yes	Sitka	1	1
Y	1063	Unincorporated	62.15427	-149.79892	Matanuska-Susitna	Small	No	Northway Village	0	0
Yakutat	619	Home Rule Borough	59.54694	-139.72722	Yakutat	Small	Yes	Klawock	1	1